POPULAR SCIENCE MONTHLY

JANUARY

15 CENTS

25¢ CENTS IN CANADA

NRA MEMBER U.S. WE DO OUR PART

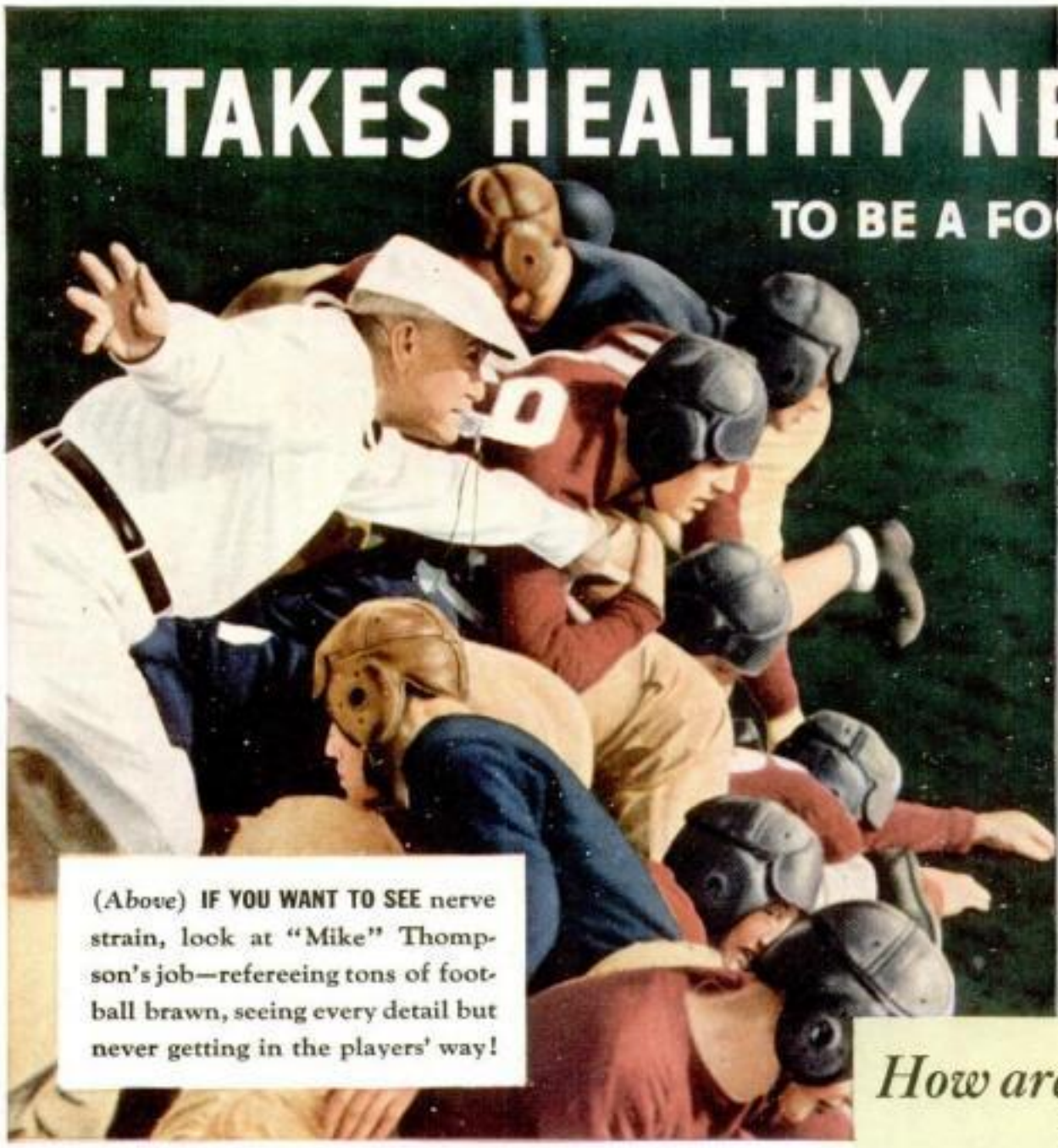
NOW 15¢

SEE PAGE 49

NEW INVENTIONS · MECHANICS · MONEY MAKING IDEAS
HOME WORKSHOP PLANS AND HINTS · 350 PICTURES

IT TAKES HEALTHY NERVES

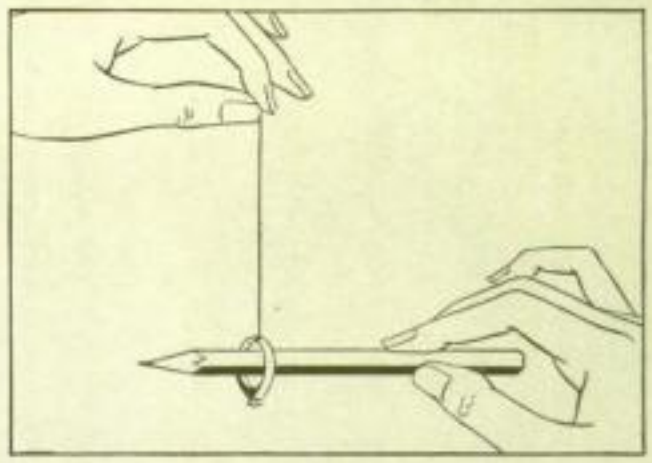
TO BE A FOOTBALL REFEREE



(*Above*) **IF YOU WANT TO SEE** nerve strain, look at "Mike" Thompson's job—refereeing tons of football brawn, seeing every detail but never getting in the players' way!

How are YOUR *nerves?*

TRY THIS TEST



Fasten one end of a short string to a finger ring. Have a second person hold string at arm's length above shoulder. The test is for *you* to make a full-arm swing downward and up... and try to put a pencil, held 3 inches from the point, through the ring. Good performance is being successful once in the first 3 tries.

George Santelli (Camel smoker), champion fencer, did it on the first try.

Steady Smokers turn to Camels

M. J. ("Mike") Thompson, football's most famous referee, is a steady smoker who has to keep healthy nerves. He says:

"Because nothing can be allowed to interfere with healthy nerves I smoke *Camels*. I have tried them all—given *every* popular brand a chance to show what it can offer. *Camels* don't upset my nerves even when I **smoke constantly. And the longer** I smoke them the more I come to appreciate their *mildness* and *rich flavor*."

☼ ☼ ☼

Many smokers have changed to Camels and found that they are no longer nervous... irritable... "jumpy." Switch to Camels yourself. Smoke them steadily. You will find that Camels do not jangle your nerves—or tire your **taste.**

CAMEL'S COSTLIER TOBACCOS

IT IS MORE FUN TO KNOW

Camels are made from finer, MORE EXPENSIVE tobaccos than any other popular brand.

—THEY NEVER GET ON YOUR NERVES

Every Needed Fact, Figure, Formula—
Every Shortcut and Special Method
in the
WHOLE FIELD OF MATHEMATICS

Now in ONE Handy Volume!

For the first time you can have this wealth of practical mathematical information, covering every trade and business, condensed into one handy book for quick reference. This volume puts right at your fingertips instant facts and formulas for making every kind of mathematical calculation. From hundreds of different sources, this priceless information has been gathered together, boiled down into brief, simple language, and applied to actual problems. Every man in business, every man in the mechanical trades, every man who ever uses a tool or has to make calculations or estimates in office, shop, or home, will find here a treasury of money-making, money-saving ideas.

THE HANDBOOK OF APPLIED MATHEMATICS

No previous knowledge of mathematics is needed. No study is required. The specific information you want is easy to find, by looking it up in the index. The book takes up every trade and gives you practcial methods, easily-worked formulas for solving every problem. Thousands of specific examples show you just how to make your calculations. If your work involves mathematics in any way this complete reference handbook is an indispensable part of your equipment. It is an amazing time-saver for any one concerned with engineering, architecture, electricity, mechanics, construction, automobiles, machinery, printing, or any other industrial work; or with accounting, auditing, manufacturing costs, taxes, or any other business mathematics. No practical man, no house-owner who makes an occasional repair, no one who has a home work-shop can afford to be without the valuable information quickly found in this book.

Simplified, Dependable Methods by an Expert

The author of this book, Mr. Martin E. Jansson, has had the widest experience in practical work. Trained as a civil engineer, he has built tunnels and dams, roads and houses; he has had years of experience in railway and industrial construction work. He has instructed adult classes at New York University. He gives you the benefit of his wide experience in this book.

Save Time—Be Sure of Your Facts

One quick turn to the index in this complete reference volume and you find at once all the facts about your subject—the best methods of doing the work, the easiest formula for making the calculations, completely worked out sample problems that show you just what to do. You avoid the expensive errors that handicap the man who merely guesses. Think what an advantage it is to have all this information gathered into one handy book that you can carry in your pocket. Act today and take advantage of your opportunity to examine this book as soon as it is published, and save 17½% off the regular price.

Save 17½% on this Special Advance of Publication Offer

The regular price of this book will be at least $6.00, and, due to constantly increasing costs of material, probably more. If you reserve your copy now, you may have it for free examination immediately upon publication. If you decide to keep it, make a first payment of only $1.25 and pay $2.00 monthly thereafter for two months—$5.25 in all. If you wish to send cash with order, inclose $4.95 payment in full. Money refunded if you wish to return the book.

Over 800 Pages. 375 Illustrations, 150 Tables.

Durable Maroon Fabrikoid Binding

See How Thoroughly It Covers The Needs of YOUR Work

- Arithmetic (including Slide Rule)
- Algebra
- Geometry
- Trigonometry
- Weights and Measures
- Mechanics
- Excavations and Foundations
- Concrete
- Brickwork
- Carpentry and Building
- Lathing and Plastering
- Painting
- Plumbing
- Heating
- Machine Shop
- Automotive Shop
- Sheet Metal Work
- Electricity (D.C. and A.C.)
- Print Shop
- Business Mathematics
- Accounting

EXAMINE THIS BOOK FREE
SEND NO MONEY—MAIL THIS COUPON

D. VAN NOSTRAND CO.,
250 Fourth Ave., New York

Send me as soon as ready *The Handbook of Applied Mathematics*, at the Special Pre-Publication Price. Within 5 days after I receive the book, I can return it and owe nothing. If I keep it I will send you $1.25 as first payment and I will pay $2.00 monthly thereafter for 2 months—* $5.25 in all.

(P. S. 1-34)

Name .....

Address .....

City ..... State .....

Reference .....

Address .....

*If you wish to send cash with order, inclose $4.95, payment in full. Money refunded if you wish to return the book.

RAYMOND J. BROWN, *Editor*
ARTHUR WAKELING, *Home Workshop Editor*
ALDEN P. ARMAGNAC, *Associate Editor*
SYDNEY OXBERRY, *Art Editor*

POPULAR SCIENCE

FOUNDED MONTHLY 1872

VOLUME 124 · NUMBER 1
15 Cents a Copy · $1.50 a Year
Published Monthly by
Popular Science Publishing Co., Inc.,
381 Fourth Ave., New York

TABLE of CONTENTS for JANUARY, 1934

January, 1934, Vol. 124, No. 1. **Popular Science Monthly** is published monthly at 381 Fourth Avenue, New York, N. Y., by the Popular Science Publishing Co., Inc. A. L. Cole, President and Treasurer; R. C. Wilson, Vice President; John Nichols, Vice President; F. W. Briggs, Sec'y. Entered as second-class matter Dec. 28, 1918, at the Post Office at New York under the act of March 3, 1879; additional entry as second-class matter at Dayton, Ohio. Entered as second-class matter at the Post Office Department, Canada. Printed in U. S. A. Single copy, 15 cents (20 cents in Canada). Yearly subscriptions to United States and its possessions, $1.50; foreign countries, including Canada, $2. Subscribers must notify us of change of address four weeks in advance of the next publication date. Be sure to give both old and new address. The contents of this magazine must not be reprinted without permission. The editors are not responsible for unsolicited contributions, and cannot guarantee the return of such material or insure against its loss. Contributions not accompanied by sufficient postage will not be returned. In presenting numerous stories of new products of applied science, **Popular Science Monthly** does not underwrite the business methods of the individuals or concerns producing them. The use of **Popular Science Monthly** articles for stock-selling schemes is never authorized.

FEATURES AND DEPARTMENTS

Cover Design by EDGAR F. WITTMACK

AUTOMOBILES

AVIATION

Don't maul *your* face with cheaper blades!

PRE-TESTED Gems are so much *sharper* and last so much longer that there's *less* shaving and *no* saving in lower priced substitutes.

We make Gems 50% *thicker* and with a deep wedge-edge to cope with *all* tough, rough and snarly beards.

We make Gems of *surgical* steel so even-grained, so tough that we can strop 'em 4840 separate times without frazzling their texture or temper.

Gem Blades are *so* much tougher than *any* bristle that *no* stubble can halt their smooth, swift, tugless action.

The New Gem Micromatic holder works like the barber's razor—with a long, purring glide instead of mincing, *choppy*, little strokes. Locks the blade unbudgingly at *five* points. And dual-alignment *(exclusive patent)* sets the edge so exactly that you can't scuff the tenderest skins, skip a hair, or skid a contour.

Gem's flat bevel frame reaches into dimples, wrinkles, and under the most difficult nostrils—cuts the beard so *closely* that once-over, once a day keeps the bluest of jaws socially fit for 24 hours.

Bust-proof, rust-proof and *guaranteed*. Fits both single and double-edge blades (provided they're Gems). Sets at $1.00 on sale everywhere. De luxe Christmas sets at $5.00 and $6.00. Or a trial outfit for men *who must be shown* for a quarter and this coupon.

Gem

MICROMATIC RAZOR *and* BLADES

Gem Safety Razor Corp., Dept. PS-2, Brooklyn, N. Y.

Enclosed find 25c for complete trial Gem set with a single and a double-edge blade and the same gold-plated Gem Micromatic Razor now featured in regular $1.00 outfits.

NAME----------

ADDRESS----------

POPULAR SCIENCE MONTHLY FOR JANUARY, 1934

In This Issue—Hundreds of Fascinating Articles Tell the Latest News of Laboratory Discoveries, Scientific Triumphs, and Amazing New Inventions

A *Friend* in the house

"It would be a hardship for me to be without a telephone. Each evening, you see, my son calls up to chat with me. That is the brightest spot in my day."

"Mother, wouldn't it be awful without a telephone? That ice cream would never have come for the party if we hadn't called up about it."

"... then Jim grabbed the telephone and called the doctor. If it hadn't been for that, I don't know what would have happened to Doris."

THERE are many fine things in life that we take almost for granted. Health, water, sunlight, green fields, loyal friends, a home to live in. . . . Not until some mischance deprives us of these priceless possessions do we learn to esteem them at their true value.

It is in much the same manner that most people regard the telephone. Millions of men and women have never known what it is to be without one. Each day, each week, each year, they use it freely, casually, as a matter of course.

The telephone has won an important place for itself in life and living because of service rendered. To keep friend in constant touch with friend, to help manage a household smoothly and efficiently, to give larger scope and opportunity to business of every kind, to protect loved ones in time of unexpected danger . . . this is the task of the telephone.

It stands ever ready to serve you — to carry your voice and your words to any one of millions of other telephones in this country or in foreign lands. You are in touch with everything and everybody when you have a telephone.

AMERICAN TELEPHONE AND TELEGRAPH COMPANY

. . Little Stories of PROGRESS—and those who make it . . .

No. 2 of a SERIES

PEACE-TIME GUN *Shoots Liquid Metal*

THIS little tool that weighs only three and a half pounds looks exactly like a paint-sprayer. But it doesn't spray paint.

Imagine that in front of you is a massive steel boiler or a delicate piece of lace to be coated or ornamented with metal. You press the trigger of this tool and out of the nozzle comes a stream of flaming metal—bronze, lead, aluminum, gold, silver or almost any other commercial metal you choose. One instant the temperature is 5000 degrees, and the next instant there is a coating of *cold, hard* metal on a surface!

This tool came from Europe with many defects. American engineers, after spending many years of research along the same lines, saw its possibilities and set to work perfecting the tool. Although it is still short of perfection, the fact remains that its practical value has already been well demonstrated. On one project alone—the great span of the George Washington Bridge over the Hudson River, it is estimated that this metal spray-gun saved hundreds of thousands of dollars. Now, these same engineers say, it is destined to revolutionize a thousand different industrial processes.

Several years ago the pages of this magazine carried the first reports of the perfection of this tool. Immediately letters began pouring in—letters from every conceivable type of business in the country. Would it do this, would it do that? How much did it cost, where could it be bought?

To many people this revolutionary invention will not seem important. But some men will stay up nights figuring out a way to make use of it. They are men who are constantly on the look-out for new things and new ways of doing things that can be applied to their own business.

Just as thousands of correspondents are constantly sending us news reports on science and industry from every corner of the globe, so are other thousands searching the columns of this magazine every month for news of any and every useful development that they themselves can use profitably.

For it is here that men alert to the need of keeping abreast of new developments in science and industry meet on a common ground. It is here that they have the news monthly of Progress—where they can have faith in the timeliness and authority of the FIRST reports of science's new ways to help them keep ahead of the parade.

There is No Substitute *for* SECURITY!

On this Principle Life Insurance was Able to COME THROUGH the Depression Years with Flying Colors

IN THE management of the trust which men call Life Insurance, there is no place for Chance. Security is the only thing that counts . . .

. . . the Security that comes from the conservative, studied selection of investments for Life Insurance funds.

. . . the Security that comes from *diversifying* these investments . . . reducing to an absolute minimum the possibility of loss.

. . . the Security that comes from the establishment of ample reserves to take care of all contingencies — of war, of plague, or of panic.

. . . the Security that is based on a steady flow of premium and interest income, both in good times and bad, making it unnecessary to sacrifice investments to obtain cash.

How else could Life Insurance—the outstanding industry of the entire depression era—have ridden out the hurricane of the last few years? How else could Life Insurance have paid (as it did pay) three and one-half billions of dollars in claims and kindred obligations . . . four and one-half billions of dollars in loans and cash values? How else could Life Insurance have done the almost incredible thing of investing for the benefit of policyholders two billions of dollars in new securities during those days of money scarceness?

In Life Insurance there is *no substitute for Security!*

* * *

Quite similarly and even more vitally there is no substitute for Security where YOUR investments are concerned . . . where protection to your family is an issue . . . where funds for your advanced age mean something.

Life Insurance offers these things with a degree of certainty which no other means provides. Life Insurance has demonstrated this fact under conditions which we hope the world will never confront again.

* * *

And so Provident Mutual, with a pardonable feeling of pride in the fact that its own record during the depression years was an outstanding one, says this to you: Invest through Life Insurance. Protect your family through Life Insurance. Provide for your own retirement through Life Insurance. Naturally, we recommend that you do these things through Provident Mutual . . . but whether through Provident Mutual or some other well-established, conservatively managed company, invest through Life Insurance now. It's safe! It's sound! It's SECURE!

* * *

Does a curtailed income seem to bar your way to sufficient life insurance? If so, you will want to have a copy of an interesting budget book, "The Most for Your Money." Just mail the coupon—No obligation of any kind.

PROVIDENT MUTUAL

LIFE INSURANCE COMPANY OF PHILADELPHIA

Founded 1865

Provident Mutual Life Insurance Co.
Philadelphia, Pa.

Gentlemen:

Please send me a complimentary copy of "The Most for Your Money."

Name _____

F8M-42

Date of birth _____

Address _____

City _____

Our Readers Say

Maybe We'll Stay Indoors When We're All Air-Conditioned

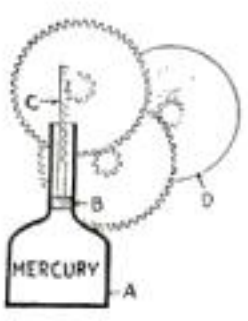
THAT item in your November issue about the air-conditioned automobile interested me particularly. With air-conditioned homes, theaters, office buildings, department stores, and now automobiles, it looks as though the average individual soon will be living in an entirely artificial atmosphere. What effect is all this incubator living going to have on our general resistance to hot and cold? Unless they air-condition the streets, we still will have to walk the short distance from the office to our car. After many hours of pure air at just the right temperature, won't the sudden change on hot summer days and icy winter nights be a little too much for us?—L. D. S., Chicago, Ill.

That Old Gyroscope Is Now Asked to Tell the Longitude

AFTER reading the article by W. W. A. of New York on reading latitude with a gryoscope I am wondering why he stopped with reading latitude. If it will work with latitude, it will work with longitude. W. W. A. says, "When a gyroscope is set in motion and its axis pointed toward some stationary point in space it tends to remain pointed toward that spot regardless of the rotation of the earth or the gyroscope's position on the earth." If that be true, then why not point the axis toward the sun, at which it would continue to point day and night if the gyroscope has a universal mounting. Then by establishing the zenith above the ship with a plumb, one could always tell the relation of the sun to the established zenith. Then by checking the number of degrees between sun's zenith and plumb-line zenith, one could know his longitude.—J. W., JR., WADE, N. C.

This Mercury Problem Will Give You Some Trying Moments

HERE is a problem upon which I should like the opinion of your readers: A steel bottle (A), with a capacity of about ten cubic inches, is filled with mercury up to the plunger (B). By raising the temperature to 100 degrees F., the mercury will expand and push upward the rack (C) which is so connected by gearing that it will wind up spring (D) which in turn is connected to the ordinary mechanism of a clock. Now the question is: How much energy in pounds could I obtain from 1,000 cubic inches of mercury expanding in the one-inch neck of the bottle with a temperature of 100 degrees F.? It is possible that I may be able to put this device to practical use if someone gives me a little help.—C. B., Freehold, N. J.



Gunboat Once Propelled by Water Forced from the Stern

YOUR recent article about a propellerless motorboat, driven by jets of water pumped astern, recalls the many interesting attempts that have been made to apply jet propulsion in a practical way. Few remember today that the British Admiralty actually fitted a 162-foot gunboat, the *Waterwitch,* to be propelled solely by pumping water in at the bow and forcing it out at the stern. The strange craft performed satisfactorily in tests, and her method of locomotion was considered a considerable advance. This was in 1865, when paddle-wheel ships still were the rule. The experiment was short-lived because of the advent of the screw propeller. But there are many today who believe jet propulsion will be applied successfully to vehicles of the future, and of course all rocket-driven machines would fall within this class.—C. G. S., Baton Rouge, La.

He Had His Moon and A Nice Rainbow, Too

UNDER the caption "Why a Rainbow? Isn't a Nice Moon Enough?," L. M. G., Lewiston, Pa., asks if anyone has ever seen a rainbow during a shower on a moonlit night. I have seen one. The occasion was a summer night about eight or nine years ago. My home faces the northwest. I stepped out into the yard, and noticed that a dark cloud was approaching from the west, and that in the cloud there was a faint, yet distinct, arc like a rainbow. I looked at it closely wondering what it could be, and then turned around to the east and saw that the full moon was about an hour high. There was no other explanation but that it was a rainbow by moonlight. I called my family and we watched it for probably ten minutes. The colors were barely discernible, but the bow or arc was perfect, and the whole effect very weird. So our family had the good fortune to enjoy a perfectly nice moon, and a faint ghost of a rainbow.—C. B. K., Bristol, Va.

This Alert Reader Finds Curvature Problem Too Easy

E. E. S., of Lamar, Neb., has had his sleep disturbed unnecessarily. His problem of earth curvature per mile, as he calls it, can be solved mentally. The cerebral gymnastics are: (1) Divide unity by four thousand and then by two mentally; result—0.000125 which represents the desired curvature in miles. Convert to inches in two steps. (2) Multiply 0.000125 by 5280. This is easiest done by pointing off three places and dividing the resulting 5.280 by 8. Result 0.66. (3) Multiply 0.66 mentally by 12. This is easiest done by adding 7.2 to 0.72. Result 7.92. The last figure is the curvature per mile of tangent on the earth's surface stated in inches. Strictly, it is the offset from a tangent to a chord, the tangent being one mile long.—C. R. S., Greensboro, N. C.

Our Artist Says He's Covered with Confusion

I APPRECIATE the good articles you have had lately on photography. Keep it up. I remember a number of years ago, before radio and television, yes, and even autos, were in vogue, that a large part of your magazine was devoted to photography. Now it looks as though it were coming back. The lure of the greatest hobby, photography, has certainly held its own, even through the depression. Twenty years ago, it was my hobby. It is yet, and also my business, and I want to say that the articles you have published certainly have been helpful. What's that: On page 80 of your November issue, the bottom part of the human being looks ladylike, and the top part looks something like a good looking young man. We don't see that kind out here in a real country. And your "man" is wearing a lady's apron with ornamental pockets 'n everything! That ought to be a good one for your next series of "What's wrong with this picture?" Anyway, "it" doesn't belong out here in Montana.—L. H. J.—Helena, Mont.

Model for Tiny Gasoline Engine Is Requested

I SHOULD like to see articles in your magazine describing the building of a miniature railway locomotive. One that can be built without the use of a lathe. Also articles on how to build a three-inch gasoline engine that will really work. Articles on electrical experiments are very interesting, as are also articles on photography, chemistry, and automobiles.—W. L., Chicago, Ill.

Reflecting on This Teaser Might Lead to an Answer

AFTER looking through every book, magazine, and periodical in every library in Los Angeles, I am writing an appeal to all you Einsteins that read POPULAR SCIENCE MONTHLY. Ready? Let's go. Of course, you all know that the closer you get to the sun the hotter it becomes and you also know that because the moon has no atmosphere the temperature on the moon is very high. So that proves that the less atmosphere and the closer a body gets to the sun the hotter it becomes. Now

why is it that the further you get away from the earth's surface in the direction of the sun, the colder and colder it becomes? Will somebody explain this to me while there is still a chance to save a bursting head?—M. K., Los Angeles, Calif.

That Overworked Magnet Gets One Final Jolt

A FEW months ago G. C. asked what maintains the energy in a permanent magnet. In a recent issue of POPULAR SCIENCE MONTHLY, F. B. K. answers this question in a way that is not satisfactory to me. Now let us explore the phenomena of permanent magnets more fully: In the first place, it is the magnetic field of the sun that drives the planets around it, instead of the field of gravitation, as Newton thought. For if such were the cause, the planets would follow the sun in a fashion of geese following their leader. Now, when we make a permanent magnet by the use of an electromagnet, it means that we dispel free electrons from a piece of iron, thus permitting the magnetic waves of the sun and the earth to pass freely through said piece of iron. Thereby we have made a permanent magnet. Such a permanent magnet upon the planet Mercury would be three times as strong as on earth, while upon the planet Pluto its power would be very small. For a similar reason, a permanent magnet produces more energy than is put into it, as it is self-evident that a waterfall will produce more energy than it took to open the sluice. The reason why other elements are not adaptable to serve as permanent magnets is because neither their protons nor electrons remain in a parallel plain when under the influence of magnetic waves.—F. A. R., Cleveland, Ohio.

A Nose Dive in a Plane Would Settle This Problem

I HAVE a question which might be of interest to some of your readers. In school I learned that the difference between a gas and a liquid is that a gas fills the container it is in while a liquid keeps the same volume for all containers under equal conditions, and takes the shape of the container. A thought came to me that perhaps the force of gravity made liquids have a definite volume or level. What would happen if gravity could be neutralized? Would a liquid under such conditions fill its container like gas? A test could be made in a fast elevator or a diving airplane. At the point where acceleration and gravity balance, what would happen to some water in a bottle?

I wonder if some of your readers could answer my question.—B. S., Sea Cliff, N. Y.

Amateur Science Club Is In Tune with the Times

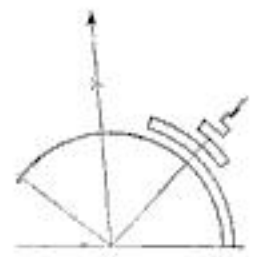
YOU and your readers may be interested to know that we have just organized an Amateur Science Club in this neighborhood. The purpose of the Club is to aid its members in scientific research and experiments. At present we are exclusively studying rock crystals and formations. We are regular readers of POPULAR SCIENCE MONTHLY and feel that other communities might be interested in forming clubs similar to ours.—YOUNG SCIENCE CLUB, Salem, Mass.

That High-Altitude Steam Engine Still Leaves Him Cold

W. H. OF New York, backs up a recent claim that a steam-driven plane gains in efficiency the higher it goes, but he fails to present convincing evidence. He says "The exhaust in the new plane's engine leaves directly from the boiler." From which I infer that he means the exhaust leaves directly from the engine and is discharged through the outlet of the combustion chamber to increase the draft through the burner similar to the system used in a locomotive. This is a common practice. But why should anyone claim that this system would be *more* efficient five miles up, where a good portion of the heat generated is needed to raise the sub-zero temperature of the air before it can generate steam, than it is at sea level where the air is comparatively warm and about twice as much oxygen available for combustion in every cubic foot of air used?—J. N. F., Storrs, Conn.

A Nifty Little Method for Trisecting the Angle

ONE often hears that the trisection of the angle by compass and straight edge is impossible. This is only partly true, for any angle may be trisected to the billionth part of a degree, if compass and straight edge capable of such precision can be found. Ever since the ancient Greeks propounded the problem, students have been attempting its solution. Many methods have been proposed, but all of them have been either crude approximations or complicated constructions. The following method has the advantage of extreme simplicity and of being accurate. To trisect an angle first draw an arc across it from side to side; reverse the direction of rotation to the mid point of the arc; reverse again, going back to the middle of the half. Continue these reversals making each new arc half as great as the one before. If the radius is increased with each reversal, the oscillations soon straighten into a line. The accuracy with which this line trisects the angle depends only upon the number of reversals made, that of the illustration being correct to the thousandth part of its arc.



By repeated bisection, an angle may be divided into two, four, eight, or any power of two equal parts. In this way, if it be divided into 1,048,576 equal parts, the trisection point will lie tightly squeezed between the 349,525th and the 349,526th marks, and will be correct to the millionth part of its arc. It can be shown that this method will never give the exact trisection point, even though carried to infinity. It therefore does not theoretically solve the Greek problem.—T. A. C., Campbell, Calif.

Just a Farewell Shot at the "Brains of Biologists"

I, TOO, am amazed at the smug dogma of C. C. J., Nanticoke, Pa. I also note the following statement made by J. H. P., London, England: "There is, in any modern book on biology, proof of even more ancient ancestry, namely, evidence in the human embryo of fish descent." There is a similarity in some of our adult humans to the fish, the sucker types, who are willing to swallow any lure cast upon the waters. For twenty years I have tried to analyse the term "proof" as applied by some scientists and in this connection wish to ask J. H. P. to study, without prejudice, the mystery of life and of human superiority. Many terms in the language of science cover much ignorance. They are sometimes used dogmatically in attempting to reach a "proof." We are willing to accept facts which are facts, but "facts" that require a philosophy for their substance are only theories. There are qualities; there are quantities. Our science of qualities lags behnd the science of quantities. Brains of biologists are fogged. We must be careful with our "proof." We are not without a definition, but for an understanding we meditate on the use of such terms as cromosomes, protoplasm, sperm, life, and imbecility.—C. A. S., Costilla, N. M.

Now Is There Anything Really New Under the Sun?

WHEN I arrived at page 21 of your November issue, I looked to see if the year-date was 1933 or 1733! The reason was those disk-shaped paddles you say a New Yorker has invented for swimmers to strap to their hands for increasing their speed. More than 200 years ago, when he was in London as a young man, Benjamin Franklin startled Englishmen by swimming down the River Thames aided by exactly the same kind of hand-paddles. I saw a drawing of it only a few days ago. Imagine POPULAR SCIENCE MONTHLY two centuries behind the times! As a matter of fact, I have been playing a frendly little game with you for a long time, trying to catch you printing an old one. This is the first one so far and I want to make the most of it!—E. R., San Francisco, Calif.

One Last Word to Solve the Mysteries of Light

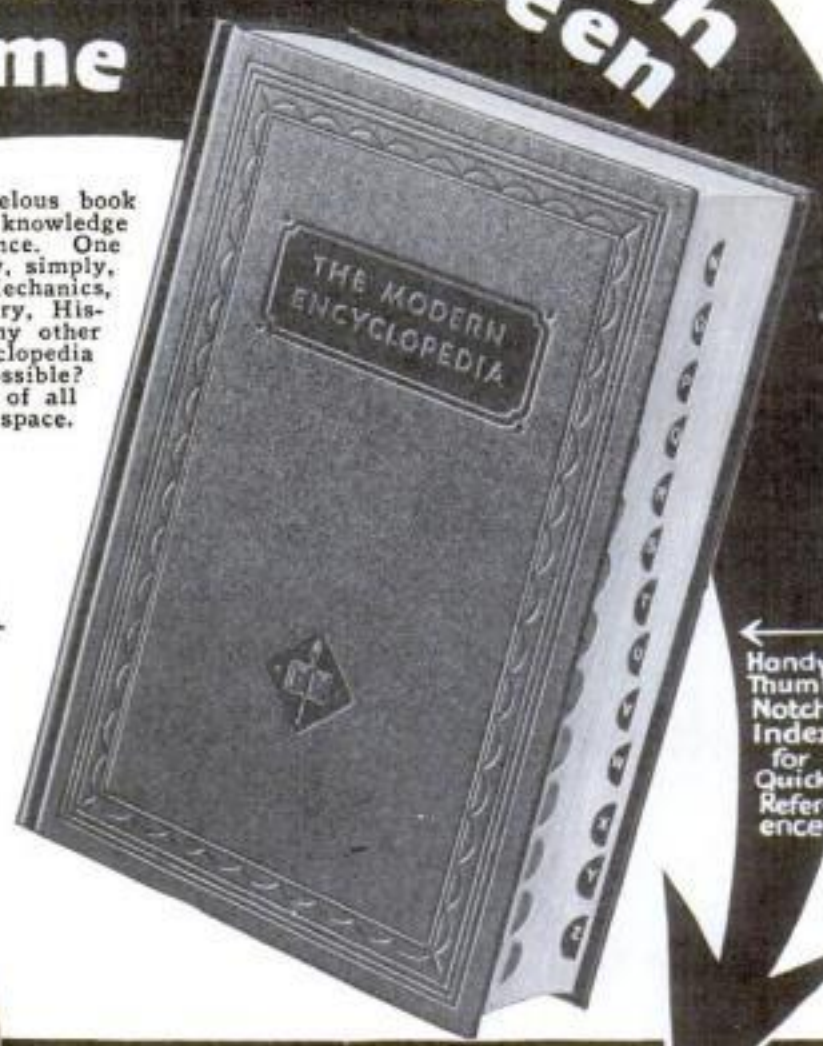
I ENTIRELY disagree with J.K.G. and his red-hot needles in a beam of light. If this were the case, we could see the beam at an angle in space as well as in direct line. This, however, is not the case. Although the earth shuts off a very small portion of the sun's rays, it apparently ceases to shine at night. Light is merely energy traveling through space at the rate of 186,000 miles per second. When suddenly halted by material substance, it is reflected in the form of light. When gradually halted, it both reflects and penetrates (as in water) and the degree of transparency is measured by the suddenness of the halt. We see the beam of a search light from an angle because the atmosphere reflects it. The denser the atmosphere, the greater the reflection, as in clouds. It takes energy to reflect a light beam and this energy is converted into heat; hence, the reflecting body gains heat during the period of its reflection. —M. R. Q., Los Angeles, Calif.

First in Our Pages and Then All the World Has Them

I LIKE POPULAR SCIENCE MONTHLY because it is always full of sound, practical ideas. I have the issues almost complete back to and including 1925. It is interesting to dig out the old numbers once in a while and see the great number of ideas advocated in them that have since become well-known commercial products. . . Radio is my hobby so naturally I want lots of radio. How about a five-tube "Super Het" using the new two-volt battery tubes? Give the country radio bug a treat and see how we like it.—M. H. B., Portersville, Ohio.

Never Before Has So Much Valuable Information Been Gathered Into ONE Handy Volume

In this one marvelous book every branch of human knowledge is recorded for instant reference. One handy volume that answers quickly, simply, briefly, your questions in Science, Mechanics, Invention, Engineering, Physics, Chemistry, History, Business, Geography, Biography, or any other subject. The complete scope of a 20-volume encyclopedia is covered in this one volume. How is it possible? Simply by an intelligent, common-sense boiling down of all material to the *essential facts*. No waste of words and space. Just the facts you need on every subject under the sun!



← Handy Thumb-Notch Index for Quick Reference

The MODERN ENCYCLOPEDIA

The Scope Of 20 Big Volumes in ONE Handy Book

At last—an encyclopedia you can really use! For generations, historians, scientists, scholars, have labored to gather into voluminous reference works the treasures of human knowledge. But heretofore this vast store of information has been buried in sets of many volumes that cost a lot of money, take up a lot of space, and require hours of tedious reading to get even a few simple facts. Now comes *The Modern Encyclopedia* to save you time and money! In simple, alphabetical order it gives you 22,000 short articles, each covering its subject simply, briefly, *but completely*. The information you want is here, easily found, easily read.

Only **$3.50** Complete

FREE WORLD ATLAS

Now It Is So Easy To Get The Facts You Need—Instantly

Why handicap yourself with lack of information? Mistakes may mean the loss of a contract, or even of a job, in the business world. They may mean the loss of influence and prestige in social life. Why guess at facts when accurate, authoritative information can be right at your fingertips, just when you want it, in this complete, new, one-volume encyclopedia?

22,000 Articles. Brief but comprehensive. Simple, clear, interesting.
1,250,000 Words. Large, clear, easy to read type.
1,160 Illustrations. Made by experts, especially for this book.
Over 1,300 Pages. Absolutely opaque. Strong and durable.
Sturdy Binding. Dark blue linen stamped in gold.
Size 6 x 9 x 1¼ Inches. Easy to handle. Easy to use.

Examine It on Approval

Send the coupon below, with no money, to reserve your copy. We will notify you when the volume is ready to ship. Then send one dollar deposit and the book will be shipped prepaid for a week's examination. If not fully satisfied, return it and your dollar will be refunded at once. If you keep it, your deposit is your first payment and you pay the balance at the rate of $1 per month.

FREE—ATLAS OF THE WORLD

If you mail this coupon at once, we will send you a gift of a splendid Atlas—32 pages of 4-color maps. You may keep it free even if you return the Modern Encyclopedia.

Mail This Coupon—Send No Money

Wm. H. Wise & Co., Publishers,
Dept. 801, 50 West 47th St., New York, N. Y.

Reserve for me one copy of The Modern Encyclopedia and the 32-page World Atlas. Notify me when ready to ship and I will send one dollar deposit. Ship fully prepaid for one week's free examination. If I return the Encyclopedia you will refund my deposit at once. If I keep it my deposit is my first payment and I will send $1 each month until the Special Price of $3.50 (plus a few cents' postage) has been paid. **In any case the Atlas is to be mine FREE.**

Name .....

Address .....

.....

SCIENCE

Every branch of the sciences comes within the scope of this great book with simple, clearly stated facts on Biology, Psychology, Medicine, Physics, Radio, Aviation, Physiology, Chemistry, Electricity, Television, Mathematics, Geology, etc.

NATURE

The fascinating truths of Natural History are revealed in brief and thrilling records covering Birds, Beasts, Reptiles, Fish, Insects, Flowers, Trees, Seeds, Microbes, of all periods from prehistoric times to the present, from Dinosaurs to Whippets.

ENGINEERING AND ARCHITECTURE

From the great pyramids of Cheops to the Empire State Building, from the Hanging Gardens of Babylon to the Golden Gate Bridge at San Francisco, all the great engineering and structural achievements of mankind are presented—Bridges, Dams, Tunnels, Buildings, Canals, Railroads, etc.

HISTORY

The essential facts on every great figure and event of the past from the time of primitive man to the present day. Explorations, discoveries, wars, revolutions, alliances. National and international affairs for every period, Ancient, Medieval, and Modern.

BUSINESS FINANCE LAW POLITICS

A great wealth of constantly needed information of practical value to every man in business or professional life. Quickly found facts on every aspect of Business, Industry, Commerce, Finance, Money, Government, Civics, etc.

GEOGRAPHY

All the geographical information you need about our own land or others is yours instantly—Continents, Nations, States, Cities, Oceans, Mountains, Rivers, Lakes, Islands, Climates, Products, Seaports, Populations, Exports, etc.

ARTS

Painting, Sculpture, Music and all the other artistic activities of mankind are covered fully. The lives and works of the greatest writers, musicians, painters, sculptors of all ages are here for easy reference.

BIOGRAPHY

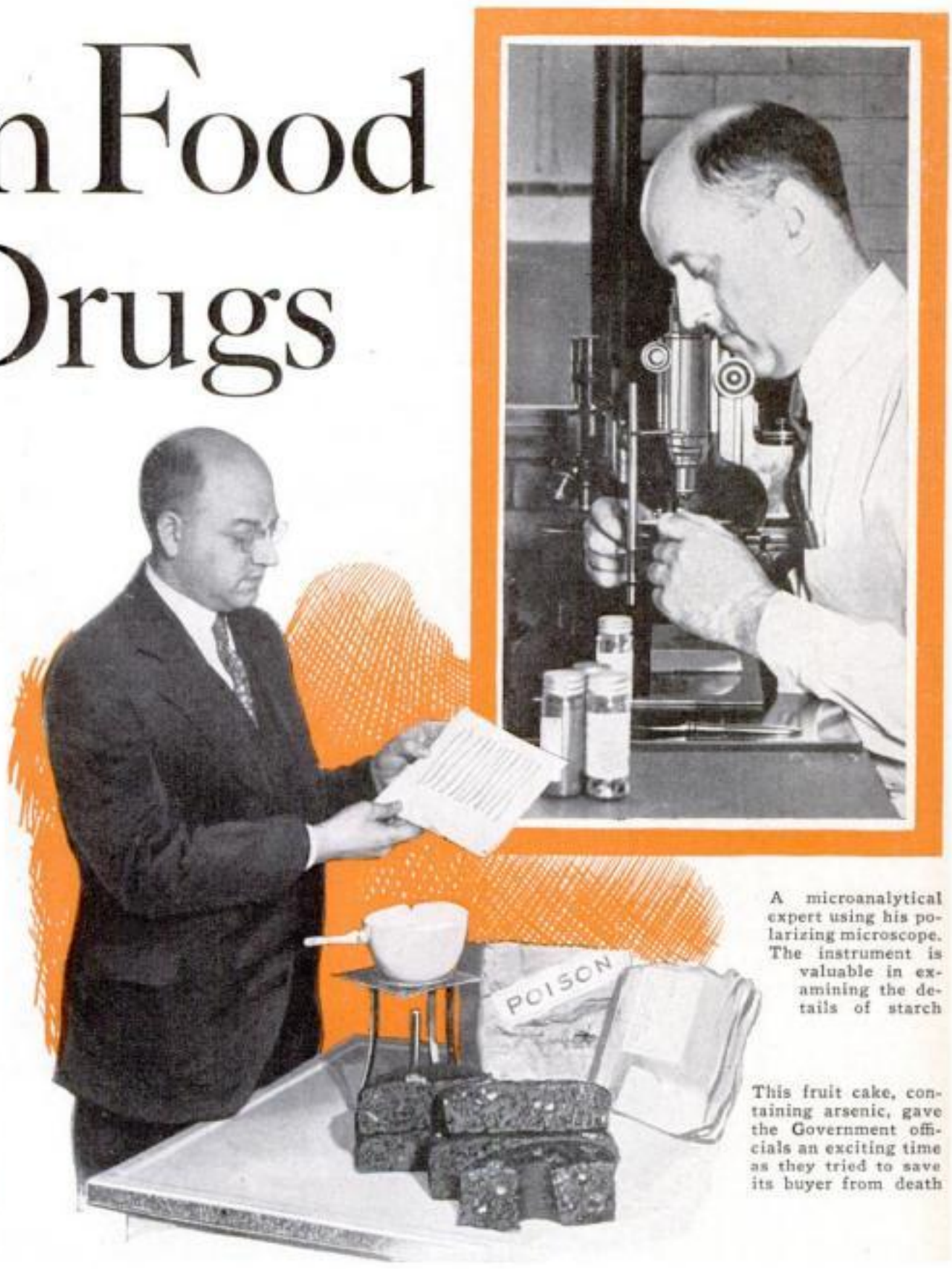
Hundreds of short biographies give you in fascinating form the important facts about the lives of great men and women of all periods of history. Scientists, Explorers, Doctors, Statesmen, Rulers, Inventors, Authors, Aviators, etc.

and thousands of other subjects..

POPULAR SCIENCE
MONTHLY
January 1934 Vol. 124, No. 1
RAYMOND J. BROWN, *Editor*

How Uncle Sam's Microscopes Fight

Poison Food *and* Drugs



A microanalytical expert using his polarizing microscope. The instrument is valuable in examining the details of starch

This fruit cake, containing arsenic, gave the Government officials an exciting time as they tried to save its buyer from death

By
WALTER E. BURTON

ON A door in one of the United States Department of Agriculture buildings in Washington are the words "Microanalytical Laboratory." The door opens into a room where the business of answering the question "What's in it?" amounts to a highly-developed science. It is here that B. J. Howard, microscopist in charge, and George L. Keenan, microanalyst, together with their assistants, turn their powerful lenses upon hair dyes, nuts, peas, patent medicines, tomatoes, beauty preparations, and the thousands of other things that the Food and Drug Administration investigates.

One day an inspector at a southern port sent to Washington a sample of coffee which he suspected of not being pure. It was in the roasted, ground form commonly employed in kitchens. To the microanalytical laboratory went the sample. At moderate magnifications, the microscope revealed that, in addition to the irregular pieces of coffee beans, there were little, relatively uniform pellets about the same color as the coffee. "What's in the pellets?" was the question now before the experts in the laboratory.

Some of the particles were separated carefully from the legitimate coffee, and were moistened and crushed into a paste. Using a higher magnification, the microscope experts discovered that the particles were made of coffee chaff mixed with rye cereal. The approximate quantity was determined. As the rye-chaff pellets formed an adulterant, the Government, backed by the indisputable evidence of the microscope, could take action against the person or company who had tried to cheat coffee drinkers by selling inferior stuff.

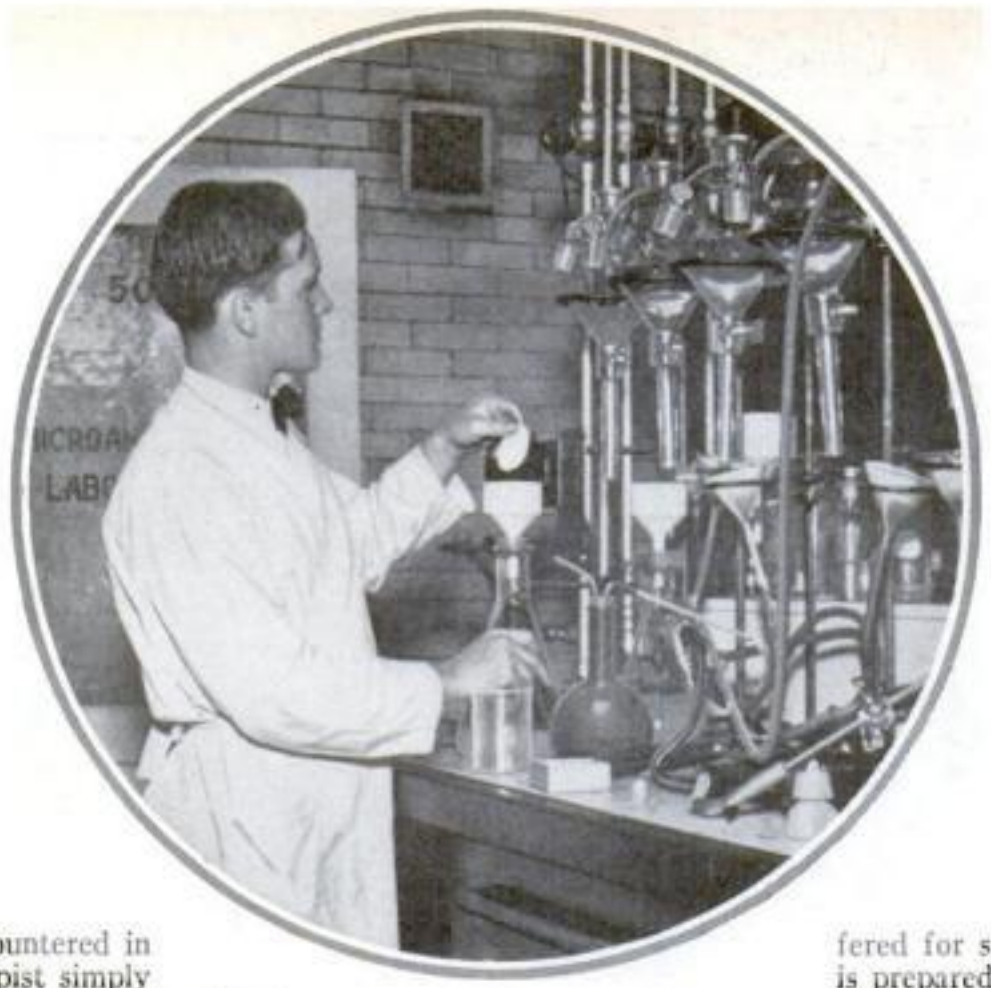
At another time George P. Larrick, chief inspector, brought Howard and Keenan a bottle containing a dark-colored liquid. It was supposed to cure diabetes if the sufferer could afford to pay $12 a pint for it. Government inspectors were convinced that it was a fake, but they had to know just what kind of a fake. So Larrick asked "What's in it?" And proceeded to find out.

Under one of the microscopes went a drop of the medicine. The analyst could see nothing that would give him a positive answer. So he placed some of the liquid in a centrifuge and whirled it several thousand times a minute. When he stopped the machine, he found, in the bottom of the containers, solid material that had been driven by centrifugal force out of suspension in the water. He smeared some of this sludge on a slide and slipped it under the microscope. A glance at the particles he now could see revealed that they were minute pieces of plant tissue. But what plant?

Answering that question was a matter of comparison. An essential part of the laboratory is a many-drawered cabinet holding scores of bottles containing samples of substances likely to be encountered in foods and drugs. The microscopist simply compared the diabetes-medicine tissue with samples from his well-stocked cabinet until he succeeded in matching them.

In the end, it was found that the "cure" consisted essentially of nothing more than water containing extract of equisetum—commonly known as "horse tail" plant. Of course, this concoction, made by boiling the plant in water, was of no use in treating diabetes. Backed with this knowledge, facts that the microscope had made available, the Food and Drug Administration could proceed with a campaign against the so-called medicine.

The microanalytical laboratory affords many examples of how the microscope, an instrument which is revealing new wonders to thousands of amateurs, can reach its highest degree of usefulness. A varied collection of microscopes, each necessarily more refined and complicated than the average amateur instrument, keep their watchful eyes on the nation's health. They do this by revealing secrets about the foods and drugs offered for sale to the public by the manufacturers.



Here is one corner of a Government laboratory showing some of the apparatus used in the effort to prevent food and drug adulteration

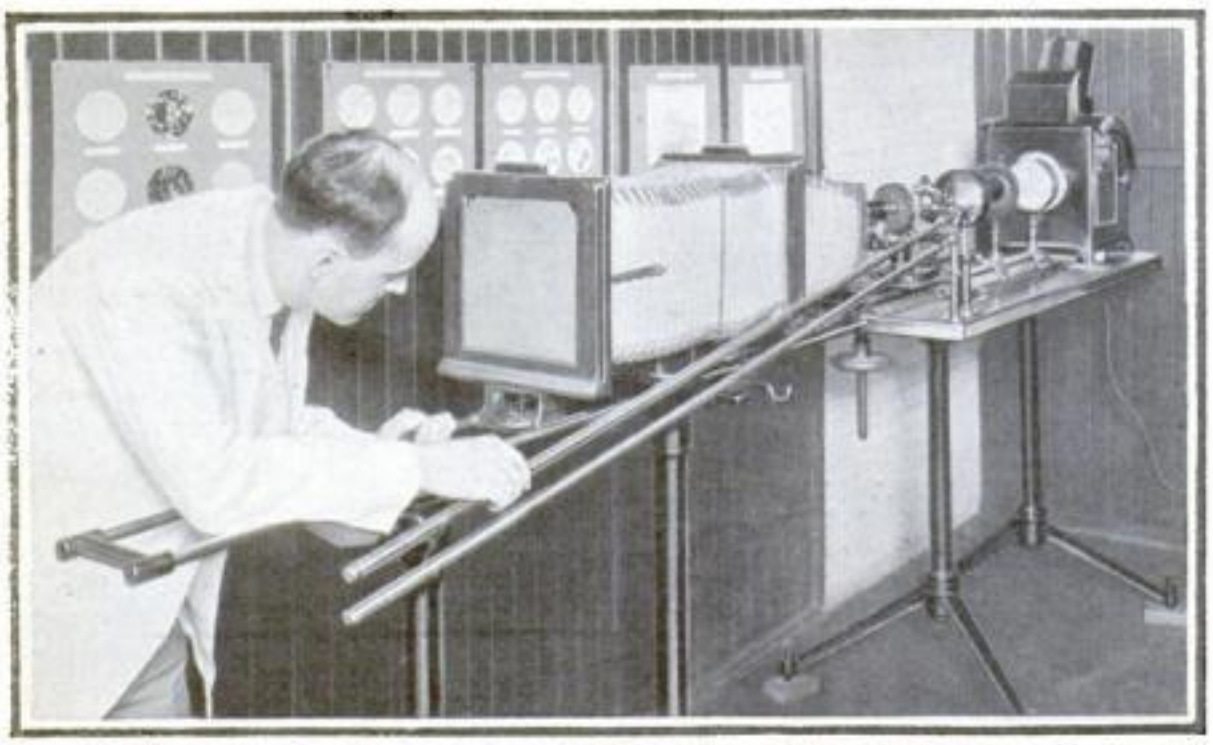
The present food and drug act, which is so inadequate for present-day needs that it is expected to be replaced soon by a new one, was put into effect in 1906. The Food and drug Administration was created to enforce it, and the microanalytical laboratory soon became a court of last resort in the matter of answering scientific questions. Some years ago much of the routine work was transferred to field stations of the Administration, located in various cities of the United States, including those which are important seaports.

Seventy-eight inspectors keep watch over food and drugs that are shipped into this country from abroad, over patent medicines offered for sale, over canneries where food is prepared—in fact, over all food, drugs, and other articles that come within the interest of the Administration. Samples are analyzed by highly trained men at the field stations.

Occasionally these stations encounter difficulties in their analyses, so the specimen in question is sent to Washington and turned over to experts in the well-equipped laboratories. Perhaps the answer can be found by the chemist, the poison expert, or other scientist. Sometimes the only way to find an answer is by intensive use of the microscope.

When enlarged 150 times, the crystals in aspirin appear as shown in picture above

Brucine, a poisonous alkaloid, treated with zinc chloride shows crystals like these



George L. Keenan, of the Food and Drug Administration, using a photomicrographic camera

The microanalyst, according to Keenan, must be a kind of super-scientist. He must know a great deal about chemistry, physics, biology, zoology and, of course, microscope technique.

"He must have also a photographic mind," Keenan added. "He has to study and learn to recognize hundreds of drugs, plant tissues, insects and insect parts, flower pollen, molds, chemical compounds, and crystals. It is by comparing an unknown substance with a known material —which may be in a bottle on the desk or in the analyst's mind—that he is able to identify the substance."

• *INVISIBLE CAUSES OF DISEASE AND DEATH FOUND*

THIS article describes for you the manner in which scientists use the latest aids to research in their efforts to discover and ban from the market adulterated products government inspectors find

In this cabinet, left, the government keeps standard samples of drugs that are likely to be encountered in adulterated foods. Comparison with these samples identifies the ingredient found by the microscope

Above, grains of potato starch enlarged 125 times, viewed under ordinary light. Upper right, the same grains, similarly enlarged, but viewed under polarized light microscope which brings out details

Photomicrograph, enlarged about 200 times, of mold filaments that are found in rotted food and which cause sickness and even death

Government inspectors are constantly on the alert to secure samples of food and drugs, as shown at the left, before they leave the warehouse for shipment

But being able to recognize a particular drug or a food mold is not enough. The analyst must be absolutely certain that he is right. The Government, in prosecuting offenders of the food and drug law, often bases its entire case upon information revealed by the microscope; and more than once a microanalyst has had to take his instrument into court and show the judge and jury what it was all about.

Delicate manipulations under the microscope sometimes are the only means of answering questions that may involve the safety of scores of persons. A dramatic fruit-cake poison mystery affords an example.

There was a woman who made and sold fruit cakes that were popular during the holiday season. She disposed of all the cakes in a certain batch, with the exception of one, to local customers. The exception was obtained by a woman who traded a bottle of vanilla for it.

Some time after the last cake of the lot had been disposed of, one of the customers, not waiting for the arrival of Christmas, ate some of the confection, and became ill. Food and Drug authorities heard about it, and concluded after a hasty investigation that the cakes contained poison. They did not know what poison, and therefore could not trace it immediately to its source and prevent further distribution. While the laboratories were working feverishly on the problem, food and drug inspectors were rounding up all of the poison cakes. They found them—with the exception of the one obtained by the vanilla seller.

The maker of the cake recalled that the woman was going to send the cake to a relative in Canada. But no one knew the woman's name, nor the name of the company for which she worked. However, by checking through a newspaper want-ad department, her home address was found. Then it was discovered that she had left for parts unknown, for the holidays. Eventually her brother was found, and from him was obtained the name of the Canadian relative to whom the cake had been sent. Canadian authorities were notified.

Meanwhile the microscope mystery-solvers were at work. Chemists had been unable to find enough of the poison to identify. So the microscope experts, after trying other tests, placed a small quantity of material from the cake on a microscope slide, added reagents that are used in testing for known poisons, and examined the precipitates formed by the chemical action. The poison was recognized in this way as an arsenic salt.

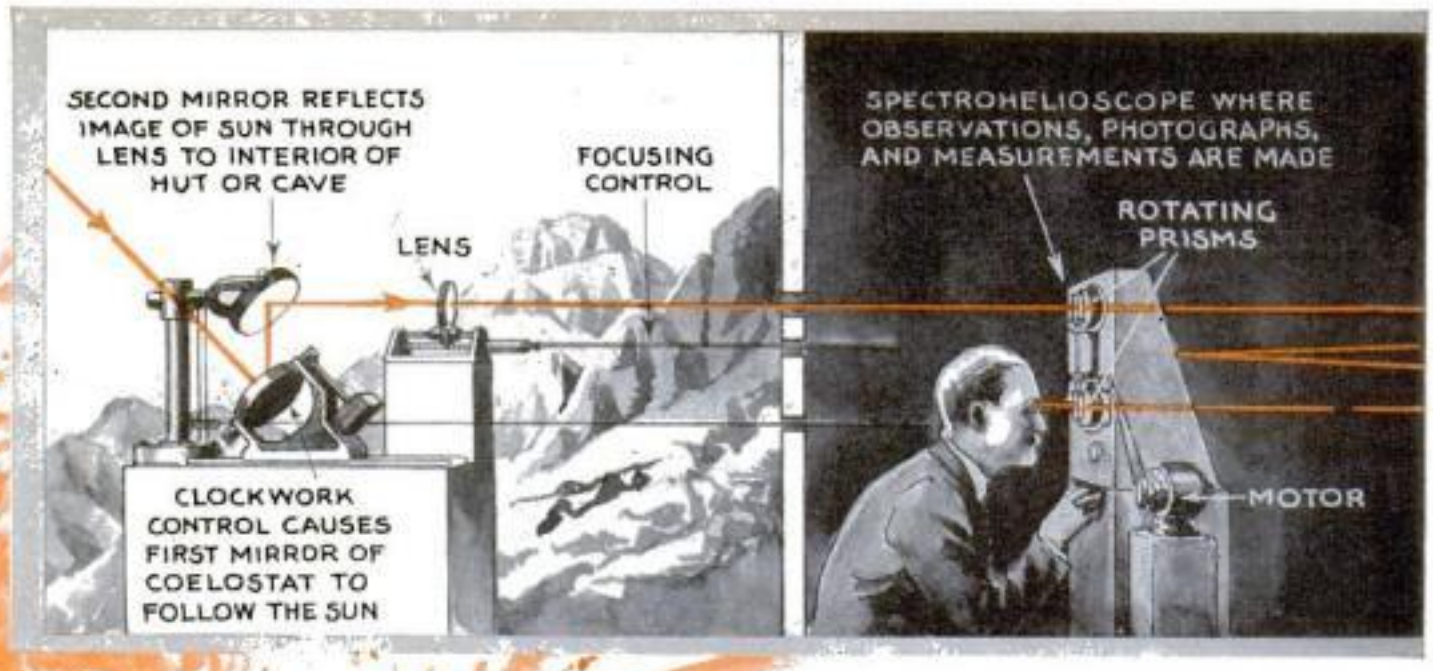
Another intensive search was launched, this time the quest being for the source of the poison. After arduous investigation, a sack that had contained poisonous insect-spray ingredients was found in an ash can. It formerly had occupied a shelf in a room where a barrel of flour, used later in making the cakes, was stored. No one knows exactly how the poison got into the flour.

Canadian officials finally found the cake that the vanilla woman had sent for a Christmas present, seized it, and shipped it to Washington, where it arrived on Christmas eve. It was found to be the worst cake of all—to contain enough poison to kill several people.

The old gag about cigars resembling ropes has a *(Continued on page 92)*

BY EXPERTS WHO GUARD THE PUBLIC HEALTH •

Illustration from "Signals from the Stars," by George Ellery Hale. Courtesy, Chas. Scribner's Sons



Lonely Outposts of Science

Study Cyclones *in*

The mouth of the cave on top of Mt. Montezuma, Chile, in which are instruments to record the variation of the sun's radiation. Visible in the picture is the coelostat which reflects sunbeams into the cave

By Robert E. Martin

AN ARMOR plate of invisible gas surrounds the earth and protects us against death rays from the sun!

That sensational discovery has just been announced by Dr. Charles G. Abbot, Secretary of the Smithsonian Institution, at Washington, D. C. Forty miles above the surface of the earth, Dr. Abbot found, a wall of ozone absorbs the short ultra-violet rays which would blind and kill if they reached the ground. The beneficial long ultra-violet rays pass through without difficulty.

Although the ozone is diffused throughout the upper reaches of the stratosphere, the total amount is so small it could be compressed into a layer no more than an eighth of an inch in thickness. This layer, less than half as thick as an ordinary lead pencil, is all that stands between life and death on our planet!

While Dr. Abbot was making this dramatic announcement, astronomers at Harvard College observatory and the Massachusetts Institute of Technology came to the end of a sixty-year trail of investigation. They have just solved the mystery of the sun's corona.

The source of this streaming, 10,000,000-mile halo, visible around the sun during a total eclipse, has been a riddle ever since it was first observed some sixty years ago. Many have thought it produced by a chemical element unknown to earth. The Cambridge scientists have now discovered it is a product of oxygen in the outer layers of the sun.

At the same time, Mount Wilson observers, in California, report the smallest number of sunspots in a decade. The end of the eleven-year cycle has been reached and these atomic cyclones on the sun, closely linked to our health, weather and crops, are at their minimum. During the next five years, they will steadily increase in number until they reach their maximum.

All over the world, American scientists are busy watching the sky and seeking the answers to a host of solar mysteries. Perched on a cone of rock rising 8,600 feet above a north African desert, working in a cave hollowed from the solid granite of the Andes in South America, peering upward from the flat summit of Table Mountain in the Mojave Desert of southern California, lonely outposts of science are spying on the sun.

Already they have established a close connection between flickerings of the sun and changes of weather on earth. Greater knowledge of the laws that link the two is steadily being gained.

More than fifty years ago, Samuel Pierpont Langley, later secretary of the Smithsonian Institution, in Washington, D. C., conceived the idea

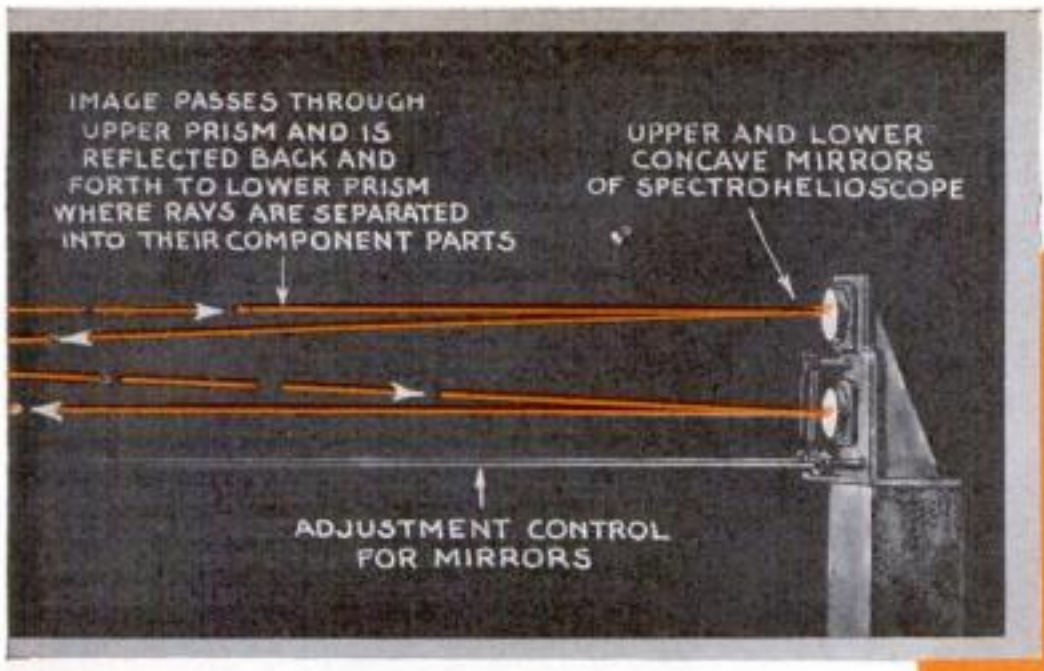


Illustration showing the manner in which sunbeams are reflected by coelostat into the cave on Mt. Montezuma where they are broken up for study by the rotating mirrors in spectrohelioscope

Dr. Charles G. Abbot, secretary of the Smithsonian Institution, adjusting his solar-radiation instruments

the SUN

that study of the sun's radiation would point the way toward long-range weather forecasting. While in charge of the Allegheny Observatory, at Pittsburgh, Pa., he began measuring the intensity of the sun's rays. However, he found, this told him little of the actual changes in the sun because the transparency of the atmosphere varies constantly, altering the strength of the rays reaching the earth. What was needed, he saw, was an instrument that would enable him to calculate the variations in intensity of the rays before they reached the disturbing layers of atmosphere surrounding the earth.

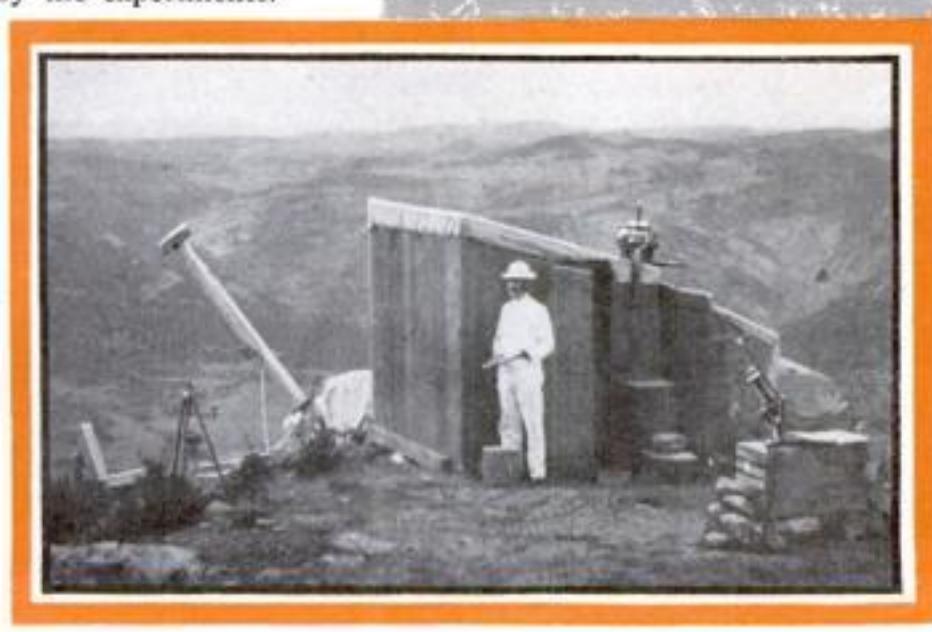
As a result, he invented his bolometer, an amazingly accurate electrical heat detector. It will record changes in temperature as small as one ten-millionth of a degree Centigrade. When such instruments are detecting changes in sun heat at several points on the globe at once, the resulting average virtually eliminates the effect of local atmospheric conditions and shows actual fluctuations in the heat given off by the sun.

In 1881 Langley took his bolometer and other delicate instruments to Mt. Whitney, in the California Sierras. Here, he not only discovered new invisible short-wave rays in the solar spectrum but also blazed the trail for later calculations in solar rediation.

A quarter of a century later, when he had become secretary of the Smithsonian Institution, he resumed his efforts at measuring the rays of the sun, placing Dr. Charles G. Abbot, present secretary of the Institution, in charge of the tests. Curiously enough, what is now considered to have been an error proved the most valuable discovery that had been made up to that time by the experiments.

In March 1903, Dr. Abbot had noted a fall of ten percent in the sun's radiation. Examination of weather reports showed a nearly simultaneous drop in temperature of over two degrees throughout the North Temperate Zone. In view of later experience, Dr. Abbot says this apparent sudden decrease in solar radiation may have been the result of an error in observation. If so, it was a lucky slip, for it strengthened his conviction that the sun's radiation varies in strength, that these variations have a profound effect upon the weather, and that study of them can be turned to man's advantage in long-range predictions.

That strong conviction has been the driving force behind the Smithsonian's work during the last thirty years. It has sent scientists *(Continued on page 90)*



Above, long-range view of the solar-radiation station on Mt. Montezuma. It strongly suggests the isolated nature of this post. At left, solar observatory set up in the field near Bassour, Algeria, by Dr. Abbot. The instrument shown records the energy received daily from sunlight

ONE-DOLLAR SHACK TRANSFORMED INTO A CHARMING COTTAGE

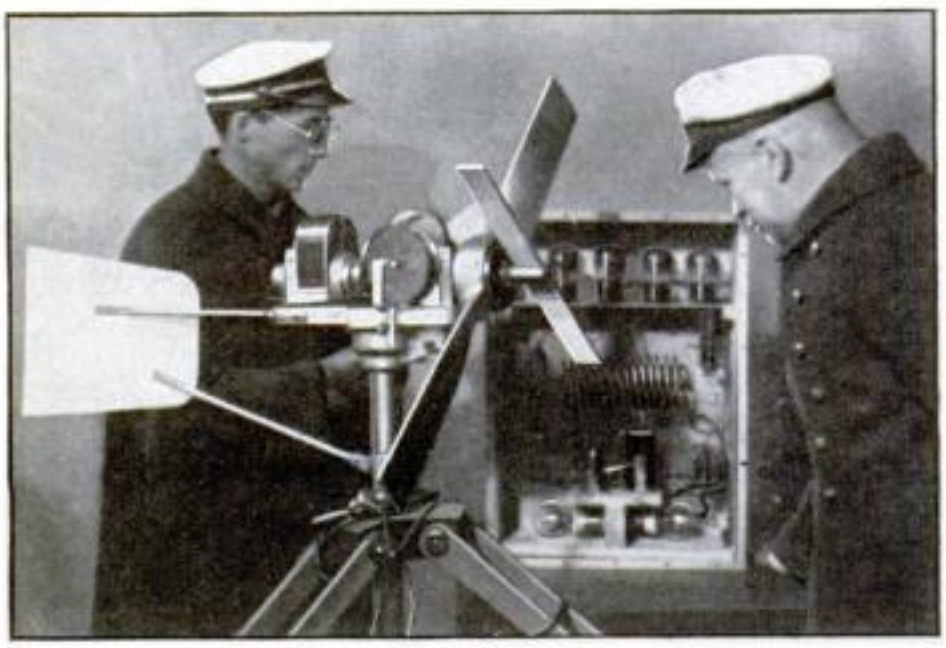
This charming cottage was remodeled by Washington, D. C. architects, at low cost, from an ancient building for which they paid only one dollar

To SHOW what can be done in modernizing a home, a worthless shack, bought from the government for one dollar, has been transformed at low cost into a charming cottage by Washington, D. C., architects and builders. They rebuilt walls, put on an addition, and shortened windows, salvaging and re-using some of the old material. Insulation was applied to walls and roof, modern kitchen and plumbing fixtures were installed, and the transformation was completed by furnishing the house in Colonial style with inexpensive, rebuilt furniture.

It was this old shack, bought from the Government, that was rebuilt into the very attractive home shown at upper left

WEATHER ROBOT FOR ARCTIC

WEATHER reports from bleak Franz Josef Land in the Arctic, where **Russia maintains a meteorological observatory, are no** longer to be transmitted by scientists stationed at this lonely spot. Instead, a self-operating radio transmitter, requiring no attendant, will periodically report, directly to national headquarters, the readings of automatic weather instruments. The robot weather man, illustrated below, is the invention of Dr. P. Molchanov, Russian meteorologist, and is a counterpart of his automatic radio transmitter.



At left, self-operating radio transmitter, which will periodically report, to the Russian weather bureau, facts concerning the weather conditions at a lonely Arctic station

HOW TO FLY IS TAUGHT WITH AVIATION TOY

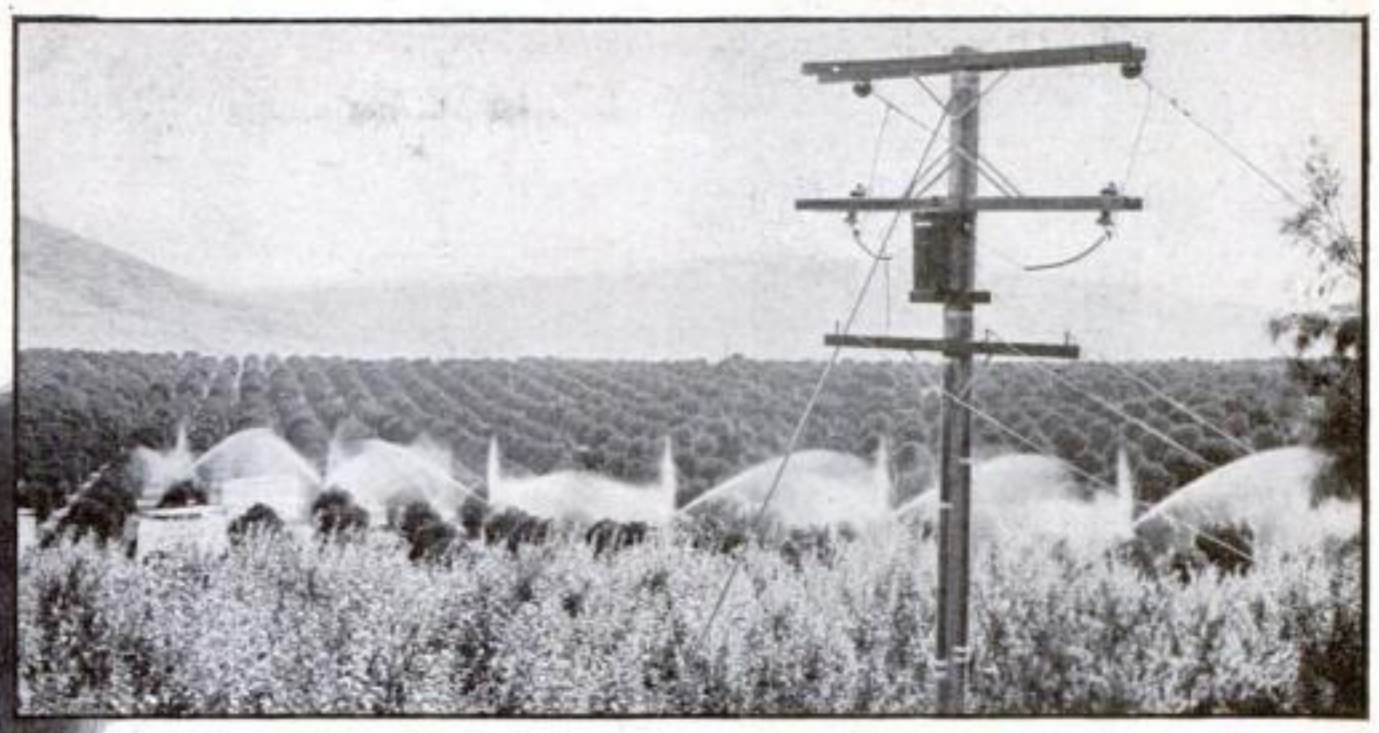
ORIGINALLY designed for use by students at a flying school, an airplane toy recently placed on the market is declared by flyers to teach children or grown-ups the principles of aviation in a fascinating way. Sitting on the floor, the user manipulates a control stick and rudder bars closely resembling those in a real plane. Thus he moves the elevator, rudder, and ailerons of a miniature airplane and causes it to dive, climb, or turn as in actual flight. Instructions show the user the correct way to perform these and other maneuvers such as the side slip, skid, loop, roll, and zoom, explaining the occasion when a pilot might need to employ them. The plane is furnished in knocked-down form and is assembled by the user, who thus learns the technique of rigging the control surfaces.

Miniature airplane, equipped with control stick and rudder bars, is used to teach flying technique. Amelia Earhart, noted woman flyer, is shown here trying her hand at the aviation toy

LATEST MODEL HOUSE HAS NO PARTITIONS

DESIGNED to give its occupants a feeling of airiness and freedom from constraint, an ultra-modern style of dwelling named the "space house" by Frederick Kiesler, its designer, was recently demonstrated in New York by a non-operating, full-scale model. The interior is almost devoid of walls and partitions, each room merging into the next. To shut off a living room or bedchamber from the rest of the house, the occupant presses an electric button, and a hanging curtain on an overhead track is run around the room by a hidden motor. Sound-absorbing draperies keep noise in one room from entering another. Where doorways are used, the doors do not swing on hinges; made of hanging slats and driven by a motor, they roll up and down after the fashion of a roll-top desk. The exterior of the fourteen-room house has a square shape and flat roof.

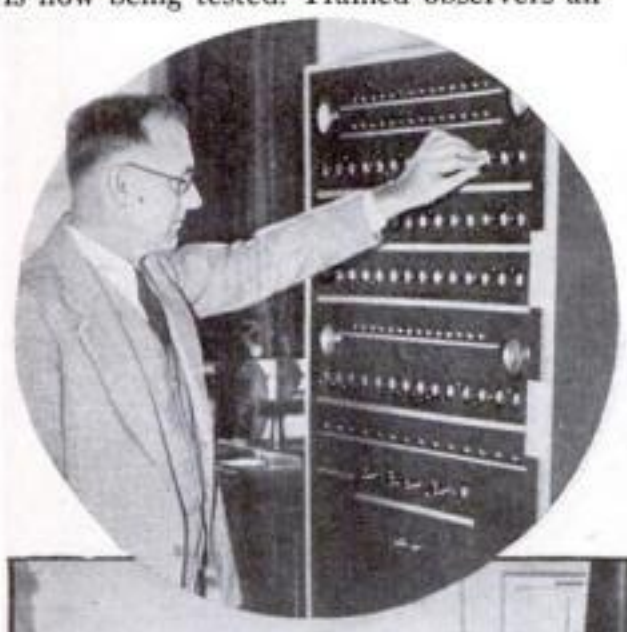
PORTABLE IRRIGATION USES NO DITCHES

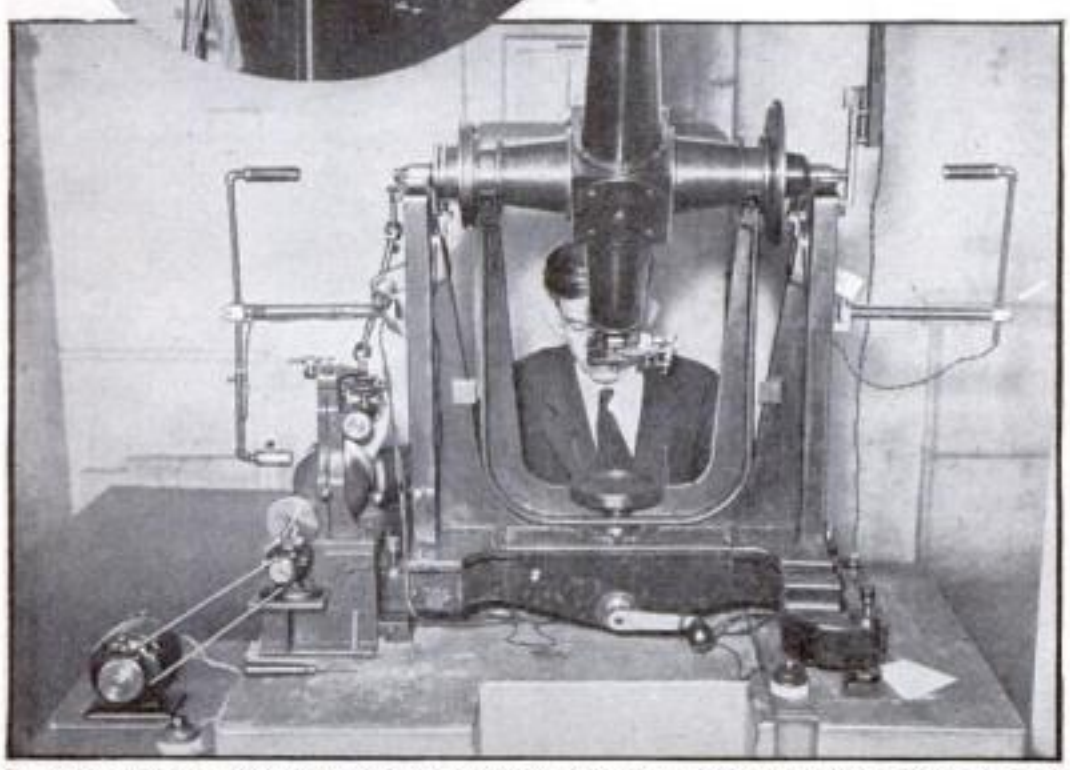


PORTABLE irrigation, an innovation that does away with the cost and labor of digging ditches, is being tried out successfully in California. The new system enables two men in an afternoon's work to irrigate hundreds of acres. Light-weight sections of galvanized pipe carry the water without loss by evaporation or overflow, and it falls on the land like rain as seen above. The sections are speedily assembled or detached with the aid of a flexible, leakproof joint of recent invention, shown at the left.

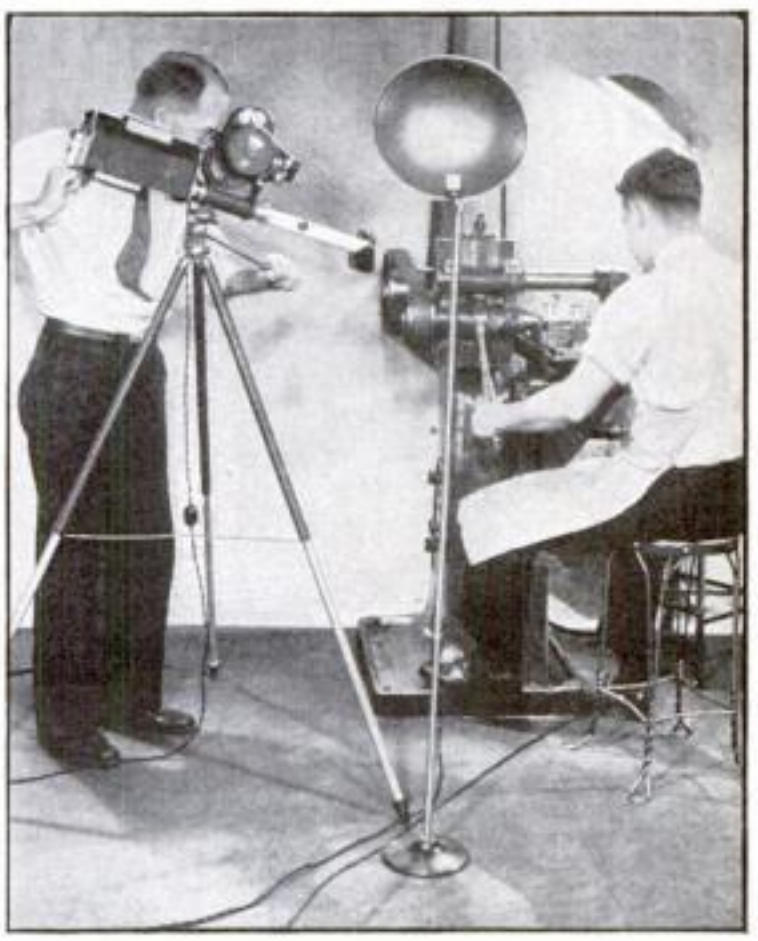
IS NORTH AMERICA MOVING WEST?

ARE the Old World and the New World drifting apart? Strong evidence that the continents may be shifting their positions is now being tested. Trained observers all over the world, several times a night, are simultaneously shooting their exact longitude by telescopic observations. To do this, each observer keeps his telescope trained on a certain star, by means of a micrometer adjustment, in readiness for a time signal sent out by the powerful radio transmitter of the U. S. Naval Observatory at Washington, D. C. Both the time signal and the position of the telescope are automatically recorded on a moving chart. The records of the stations will be compared in the hope of detecting even the slightest shift.





In circle, closing the switch that links master clock to a radio transmitter and sends signals to observers at telescopes as above, who check their longitude when the signals come in. These records are then compared in an effort to learn if our continent is drifting west



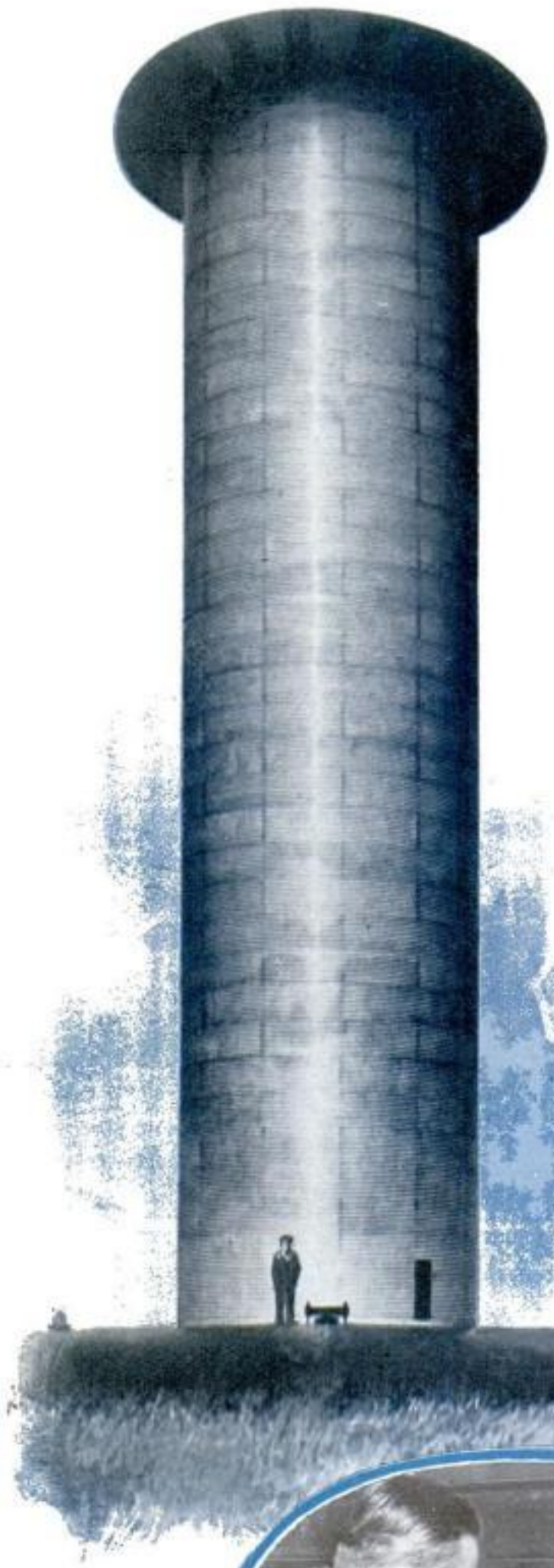
USE SLOW MOTION PICTURES TO FIND DEFECT IN MACHINE

How slow-motion pictures came to the aid of distressed engineers, when trouble developed in a new machine of apparently sound design, is shown in a case recently reported by a Chicago camera manufacturer. Why envelopes jammed in a high-speed addressing machine, scheduled soon to be placed on the market, was a baffling mystery. The feeding pawl was painted white, and movies were made of the feed mechanism in action, as illustrated above. They showed that the pawl vibrated from time to time, undetected by the eye, and that each time it vibrated it failed to feed an envelope. Knowing the trouble, it was easy for the makers to find the source of vibration. After which the engineers were able, quickly and permanently, to correct the fault.

Spinning

RUMBLING with the sound of a distant freight train, a spoollike tower of duralumin as high as an eight-story building spins on its base at Burlington, N. J. It represents the first step toward realization of a daring plan, fantastic as a Jules Verne dream, to harness the wind for the purpose of generating electric power.

This plan calls for the erection of a wind-power station comprising twenty such whirling rotors, each ninety feet high. The rotors will be mounted on flat cars, coupled in an endless chain on a circular track more than half a mile in diameter, and spun in a breeze by electric or mechanical power. Just as a spinning baseball experiences a sideward pull that gives it a curving flight, so the rotors, also tending to move sideways, act like sails and propel the whole train of cars around the track. Meanwhile a dynamo on each car, geared to the wheels, generates electricity and feeds



Above, giant wind rotor, recently erected at Burlington, N. J., is shown in striking contrast to the steam power plant at its right. This is the largest piece of revolving machinery in the world. At top of page, handkerchief is held up to show wind stream as caused by whirling rotor

Russell F. Hardy, chief engineer of the rotor project, reads one of the dials that show the thrust of the revolving rotor. At right, Julius D. Madaras, inventor, inspecting the motor

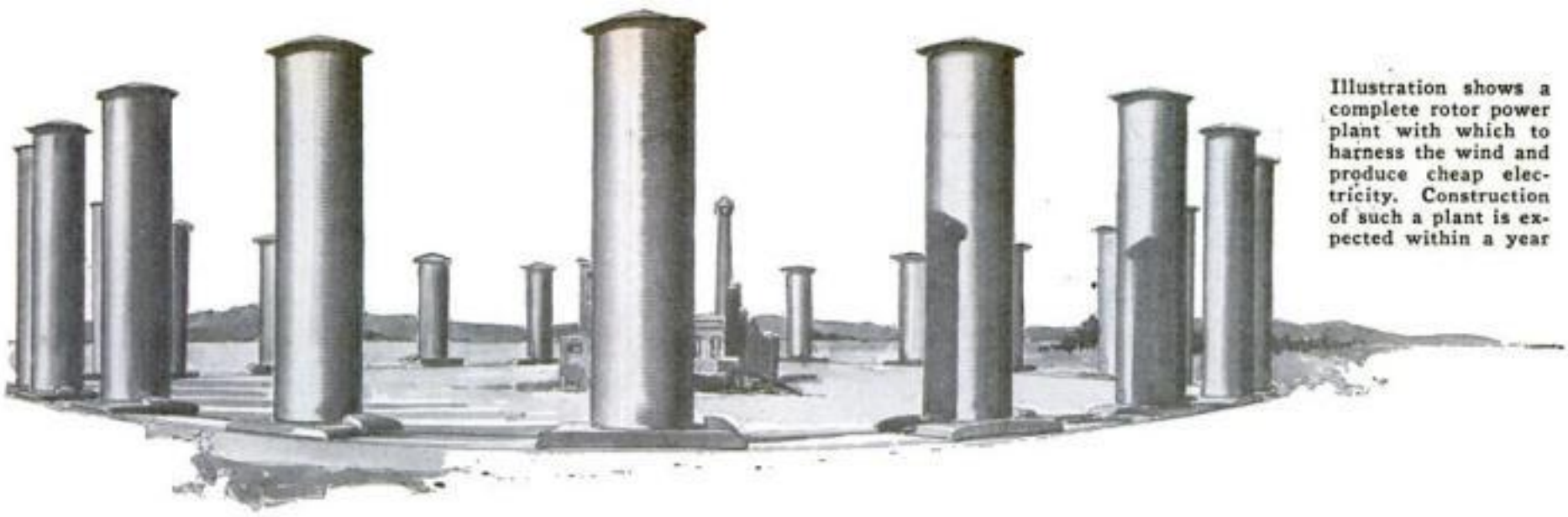


Illustration shows a complete rotor power plant with which to harness the wind and produce cheap electricity. Construction of such a plant is expected within a year

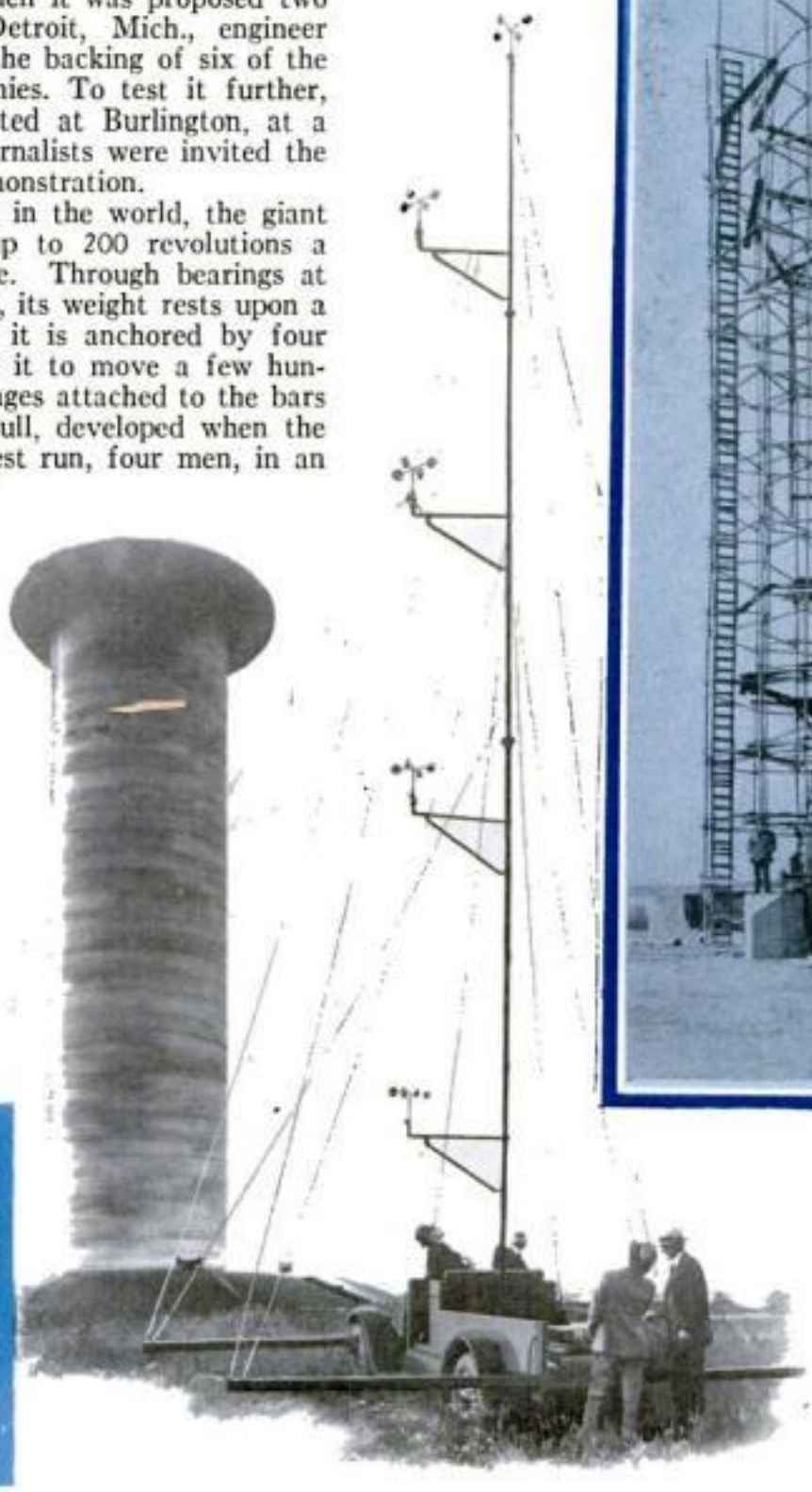
Towers PRODUCE ELECTRIC CURRENT FROM WIND

it into power lines. Since it takes only six to eight percent of the total power generated to spin the rotors, according to the inventor's estimate, the excess would provide a large supply of cheap electricity.

Visionary as the scheme appeared when it was proposed two years ago by Julius D. Madaras, Detroit, Mich., engineer (P.S.M., Jan., '32, p. 37), it received the backing of six of the country's leading public utility companies. To test it further, a full-sized rotor was recently completed at Burlington, at a cost of $140,000, and scientists and journalists were invited the other day to witness its first public demonstration.

Largest piece of revolving machinery in the world, the giant rotor is whirled smoothly at speeds up to 200 revolutions a minute by an electric motor in its base. Through bearings at the bottom of its supporting framework, its weight rests upon a massive concrete foundation, to which it is anchored by four heavy bars of springy steel that permit it to move a few hundredths of an inch in any direction. Gages attached to the bars reveal the tractive force, or drawbar pull, developed when the rotor is spun in the wind. During a test run, four men, in an underground chamber beneath the rotor, read the dials every fifteen seconds at the sound of a gong signal.

In tests so far made, the builders report, the rotor has surpassed their expectations. It strains at its moorings with more than ten tons' force, indicating that on tracks it would develop more than its rated 1,000 kilowatts of electric power—enough to light 25,000 forty-watt incandescent bulbs. In view of the success of the rotor's trials, its inventor plans to begin construction of a complete wind power plant within a year.



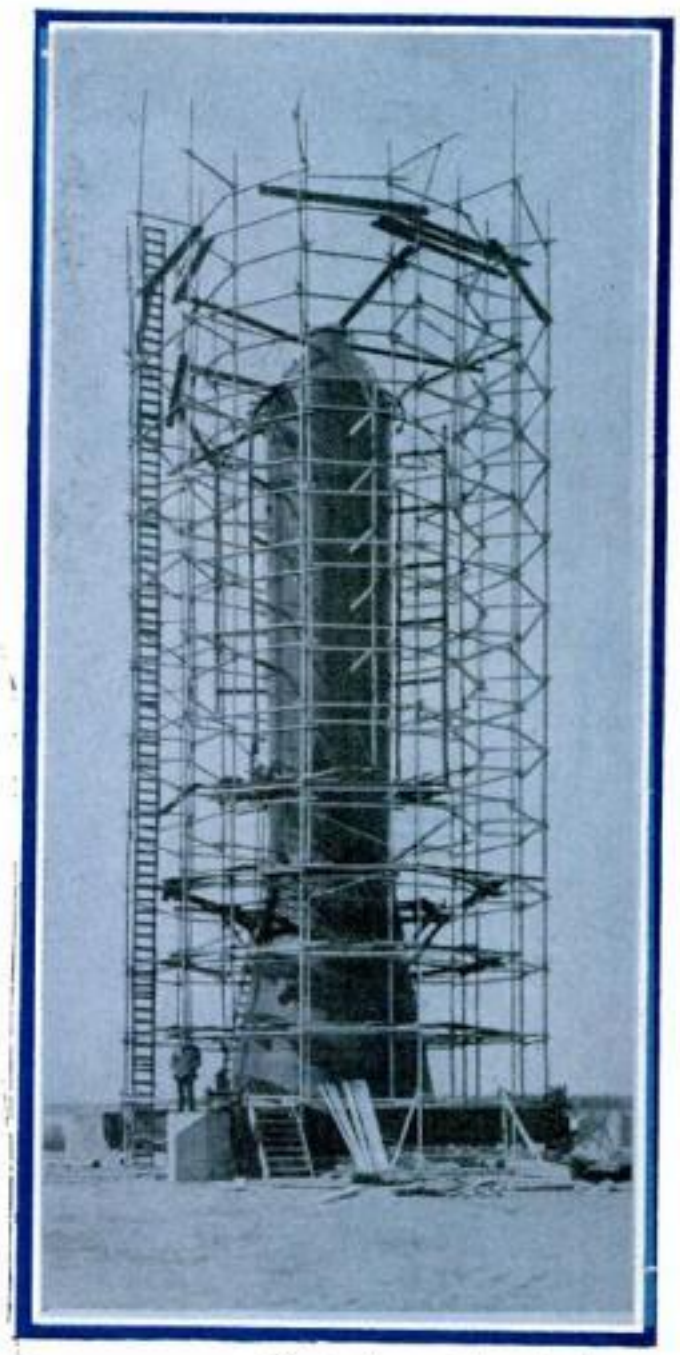
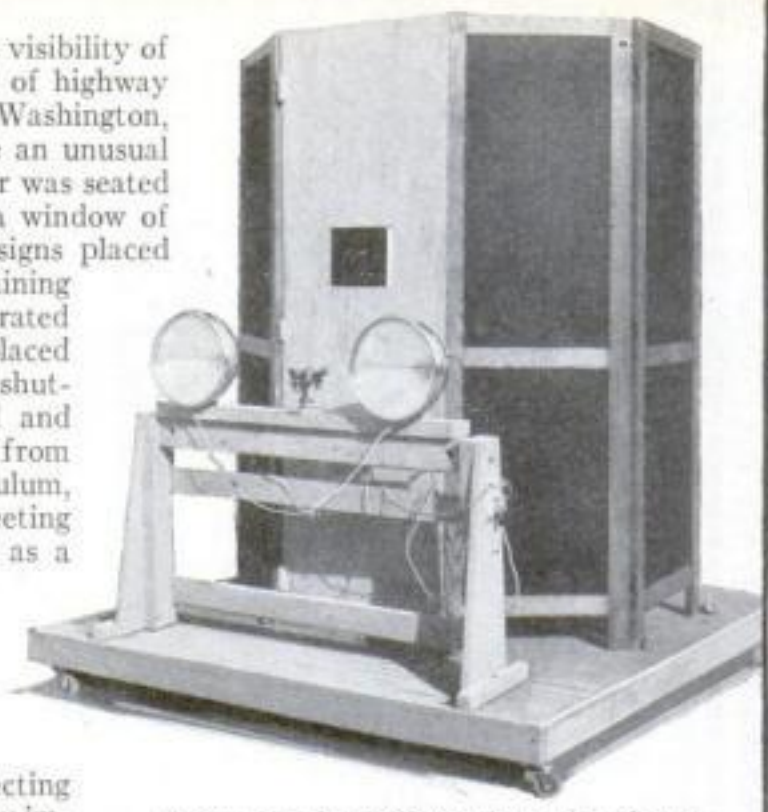


Photo above, taken during the construction of the giant rotor, shows the stationary inner framework upon which the rotor revolves. At left, wind conditions near the rotor were carefully mapped with the aid of a fifty-foot mast to which five anemometers were attached to record the wind velocity at ten-foot intervals. An instrument on the back of the truck registered each of their readings

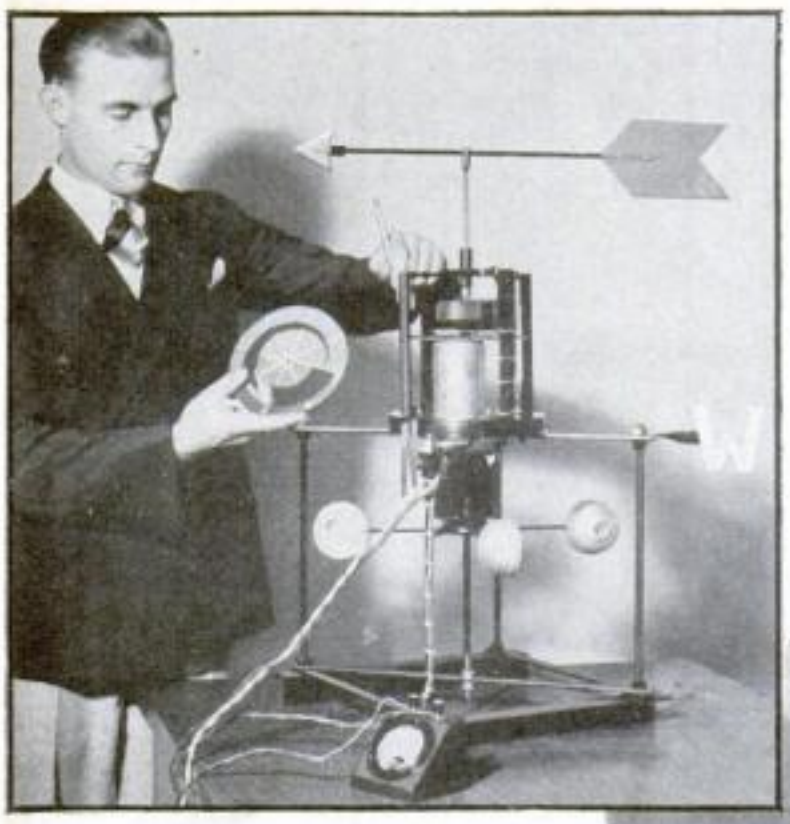
Ribbons of smoke, below, show how this model wind rotor accelerates the wind stream, creating suction that pulls the rotor

TEST VISIBILITY OF ROAD SIGNS

To COMPARE the relative visibility of different colors and styles of highway signs, federal officials at Washington, D. C., recently put in use an unusual testing device. An observer was seated within a screen, through a window of which he could see test signs placed outside. An eyepiece containing a pair of electrically operated sliding shutters was then placed before his eyes. When the shutters were rapidly opened and closed, by remote control from an adjustable timing pendulum, the observer obtained a fleeting glimpse of the sign such as a driver might get from a speeding automobile. Letters of black on a yellow background, the tests showed, could be read most quickly; while adding three-quarter-inch reflecting buttons to the letters greatly improved their readability under night-driving conditions.



Above, auto headlights and exterior of apparatus used in testing road signs. At right, sliding shutters that give a glimpse of signs



TWO BICYCLES HOOKED TOGETHER

RIDING on twin cycles may become a popular sport as the result of the invention, in Clayton, Mo. of a flexible coupling that joins two standard bicycles side by side. In this way one person may do all the pedaling, or the two share the task. Hinges on the interconnecting frame permit the machines to accommodate themselves to uneven road conditions, and even enable one bicycle to run along a curb while the other remains in the street. The frame may be made rigid by tightening a pair of chains at the rear.

This flexible frame couples two bicycles firmly together

At left, twin cycles in use. Note that the frame is not rigid but allows some play

ELECTRIC EYE GIVES WIND DIRECTION

USING an electric eye to show the position of a weather vane upon a distant dial, a wind direction indicator of unconventional type has been devised by a New Dorp, N. Y., inventor. A disk with a circular slit of graduated width, mounted on the same shaft as the vane, allows more or less light to pass from a lamp bulb to the electric eye as the vane swings. The corresponding increase or decrease in electric current generated by the photo-electric cell is interpreted directly in terms of wind direction on the dial of an electric meter. In the photograph above, the inventor is showing where the spiral disk, which he is holding, is mounted in the machine.

NEW SPOTTING SCOPE AIDS MARKSMAN'S AIM

ESPECIALLY designed for use in small-bore shooting, to enable marksmen to see where their shots hit the target, a new spotting telescope of medium price, has been placed on the market by a leading American optical firm. The telescope has interchangeable eyepieces, giving a range between twelve and a half and thirty-six powers. It can be used indoors or outdoors.

TIMER SPLITS SECOND INTO 3,600 INTERVALS

So FAST that it can split a single wave or cycle of alternating current, of which there are sixty each second, into sixty separate parts, a high-speed timer developed by Westinghouse engineers is suitable for any task from measuring how quickly a relay closes to determining the time a driver takes to apply his brakes after seeing a stop signal. A disk bearing numbers from one to sixty, representing sixtieths of a cycle, is rotated before a window, and one number is momentarily lighted by a neon lamp connected to the object under test.

BEAD CORD THAT HOLDS

INSPIRED by a list of needed inventions in POPULAR SCIENCE MONTHLY, which included an unbreakable bead cord, an Atlanta, Ga., inventor claims to have produced one. Within the cord is a strong, silk spring that holds the cord together when the braided covering frays through, preserving the beads in proper order for re-stringing.

SIGNAL LIGHTS HELP HOIST GIRDERS

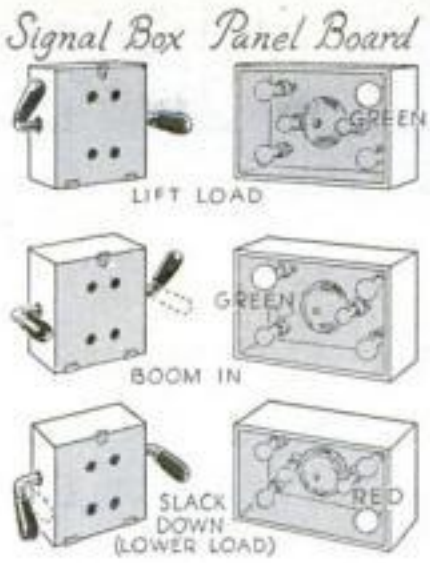
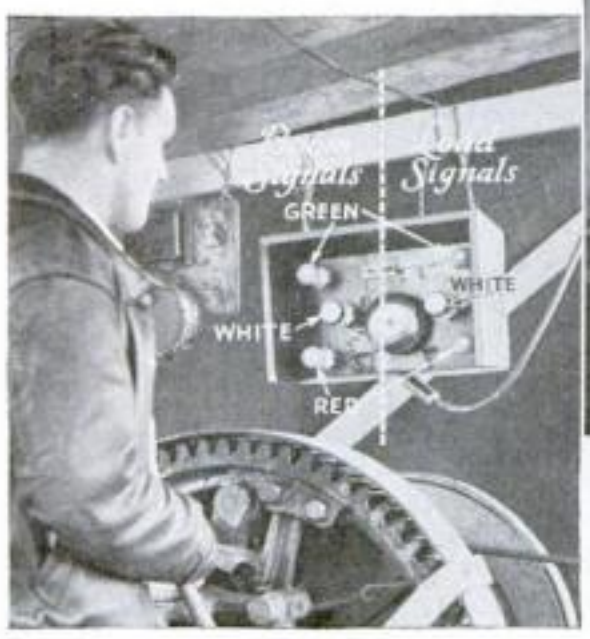


Illustration showing how code signals are given in using electric lights to aid builders in raising steel girders. These are typical signals now in use



By moving handles of the control box, above, the signal man gives instructions to the engineer who sees code lights flash in the panel that is shown in the illustration at the left

AN ELECTRIC signal system for hoisting operations on a building under construction, devised by Ralph Maxwell, New York ironworker, is said to eliminate accidents due to misunderstood hand or bell signals. The signal man stands at a point of vantage, and gives instructions to the engineer of the hoisting crane by moving the handles of a control box hung from his shoulders. Buttons on the ends of the handles provide additional means of signaling. An electric cable leads from the box to a panel in front of the engineer, where colored lights flash up in a pre-arranged code and tell him what to do. A gong sounds automatically before each new signal appears. When the signal man releases the handles, they spring back to neutral position and the lights on the board go out, signaling "stop." The accompanying photographs show the new signal system in use during the construction of a New York skyscraper, where it is reported to have proved a valuable aid.

STARS MOVE IN CRYSTAL GLOBE

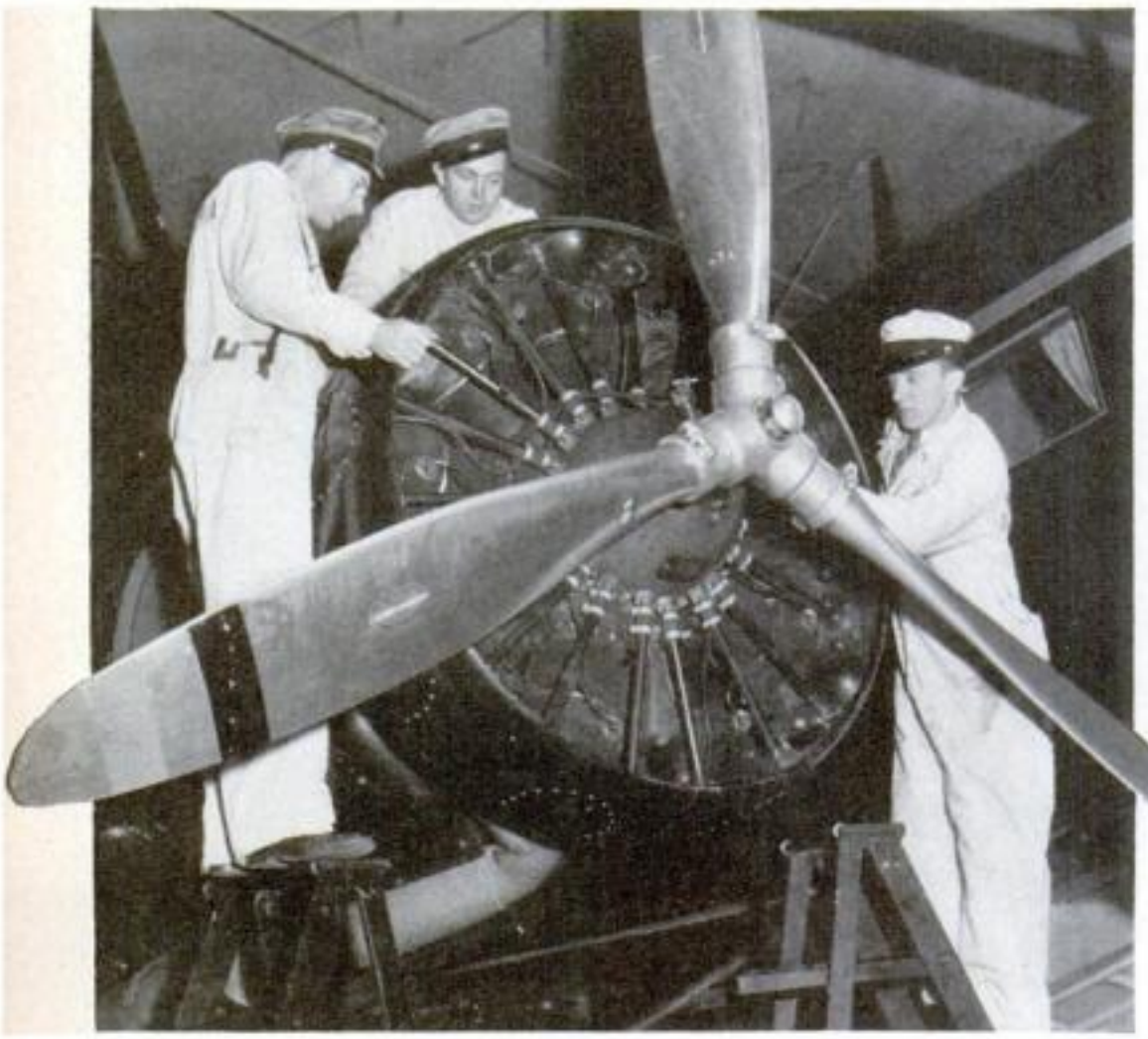
FACTS of astronomy are easily learned with the aid of a transparent globe devised by Otto J. Russert, of Hoboken, N. J. The sun and the planets are represented by figures near the center of the globe, while stars are indicated on its circumference by star-shaped figures and dots showing their positions in the constellations. By turning a thumb nut at one corner of the base, the planets are made to move around the sun in their proper orbits at their correct relative pace. The device also will show what stars and planets will be visible from any selected location at any time of the year. The magnitude of the stars is clearly indicated by their size and color.

Otto J. Russert, Hoboken, N. J., and his crystal globe on which are seen the sun and planets

NEW LAMP BURNS DIM OR BRIGHT

THREE different degrees of illumination, bright, medium, and dim, are obtained at the touch of a switch with a new lamp bulb developed by General Electric engineers. An extra contact in its base, supplementing the two conventional ones, enables its two filaments to be burned singly or in combination. Designed especially for use in stores, the bulb saves current when the rush hours of shopping have passed and less light is needed. Photo above shows contact that dims the light.

AIRLINES kept on
BY VIGILANT GROUND



The metal propellers are inspected with especial care. After 300 hours' use, they are removed and sent to the shop

At the end of a run, the pilot makes a written report of the condition of the plane. The inspector reads the report and then asks the pilot questions in order to discover any defect, however slight it may be

Little things receive the carefullest attention. At right, a bolt is being tightened on landing gear trunion

OPERATORS of air-transport lines have learned that what an airliner does in the air depends on what has been done to it in the hangar.

So, after every trip, each plane is examined from landing gear to wing tips by experienced and keen-eyed inspectors. They report even the slightest faults, and before the ship leaves the hangar for another flight each of these faults must be corrected by maintenance mechanics licensed by the Aeronautics Branch of the Department of Commerce.

Maintenance is not a spectacular branch of airline operation, so it doesn't attract the air-traveling public's attention. But it is one of the most vital factors in the safe operation of an air-transportation line. Efficient maintenance is costly, but finding and correcting possible causes of trouble before the trouble has a chance to develop pays big dividends in safety and in public confidence.

During the first six months of this year, 235,139 passengers traveled in the ships of the thirty-two American air-transport companies that operated scheduled passenger services. Of them, 235,042 completed journeys that averaged 327 miles without experiencing even a minor accident. Or the ninety-seven passengers aboard the twenty-one planes that were in accidents, two were killed. A total of over 76,500,000, passenger miles were flown. Over 38,000,000 passenger miles flown for each passenger fatality—a new safe-travel record for the air.

But air travelers are coming to regard safety as a matter of course. Few of them still regard flying as an adventure. They think of it as a way of getting from somewhere to somewhere in the shortest possible time. The Atlanta-bound business man who stretches out in his Pullman berth aboard an air liner at Newark Airport at 9:30 in the evening isn't looking for flying thrills. What he is paying for is a safe, comfortable, and uneventful journey, a good night's sleep, and an on-time arrival in the Georgia city early the next morning.

That he nearly always gets what he pays for is due, as much as to anything else, to the never-ceasing vigilance and care of the seldom-seen inspectors and maintenance crews.

Recently I received permission from Eastern Air Transport—an air line whose ships in the last five years have flown 18,000,000 miles on schedule and have carried 210,000 passengers—to spend a night in its hangar at Newark Airport and see just what happens to a passenger plane between flights. The photos illustrating this article were made during actual operations on a plane that had just finished its run.

A big, black-bodied, orange-winged Condor passenger ship taxied across the flood-lighted landing field and came to a stop in front of the Air Terminal. Red-capped porters were ready with steps. The cabin door was opened, and a dozen passengers got out and walked toward the bus that was waiting to take them to New York.

After them came the pilot and co-pilot, looking as fresh as if they were starting instead of finishing their day's work. A mechanic astride a small tractor appeared, coupled on to the Condor's tail, and with the big plane in tow, chugged into the hangar.

Schedule

CREWS

By
Arthur Grahame

In the despatcher's office, the pilot was just finishing filling in a report form, which he handed across the counter to the waiting chief inspector. Reading the report, the inspector asked questions, to which the pilot replied with brief explanations. The right landing gear brake wasn't working just right, he said, and it seemed to him that the air in the tires was just a little low. That, he admitted with a grin, was all the grief he had to report. The inspector nodded, and the pilot went out.

These meetings between inspectors and pilots at the end of flights play an important part in the business of keeping the air liners flying. Talks between men who speak the language of the air supplement the written reports, and sometimes avert dangerous misunderstandings.

Out in the chilly, brightly lighted hangar mechanics were busily at work on four of the big black-and-orange passenger planes. Just outside, motors roared as inspectors tested the engines of the ship I had watched come in.

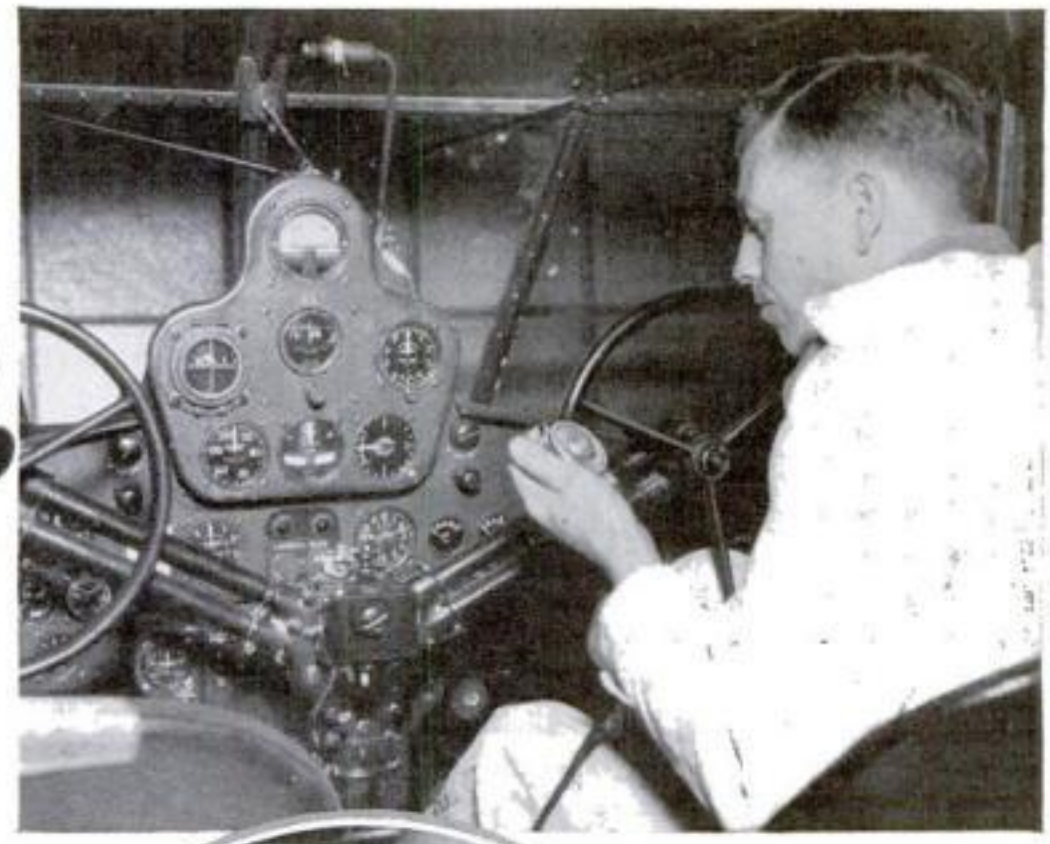
A good-natured maintenance crew chief took time off to tell me something about his job of keeping the ships fit and ready to meet and overcome the hazards of the air.

"It's always watching for the little things, and always catching them before they have a chance to get big, that keeps down the grief in this game," he said. "Here's a good example of the sort of little thing that I mean."

He turned over an inspection card hanging from the lower wing of one of the ships, and showed me a notation penciled on its back. "Cut off long screw about to rub top of right oil tank," I read.

"Now," went on the crew chief, "that's a mighty little thing, a screw a quarter inch longer than should have been used in that particular place. It isn't even a repair job, because no damage has been done. But if that long screw hadn't been noticed, it might eventually have rubbed a hole in that oil tank. That might have made a forced landing necessary. And the forced landing might have resulted in a bad accident.

"The other work ordered on this ship is along the same lines. 'Repair right rear clamp on exhaust stack.' The stack would get loose if that little job weren't attended to. 'Tighten bolt in upper trunion of right landing gear.' Two minutes work. 'Check air in tires.' Those sixteen-inch balloons are the biggest tires that ever have been made, and they sure ride nice and easy when they have in them the thirty-five pounds of air they need.



In the control cabin every instrument is checked by the maintenance crew with the utmost care. The radio set also is carefully tested to be sure it will not fail the pilot at a critical moment. This work is illustrated below

Engine mounts, as above, are inspected with minute care, a magnifying glass and flash light being used in the search

At left, a new generator is going into a plane, it having been found that the old one was defective and no chances are taken on a part that might fail in the air. This is only one of the things that show the care with which all passenger planes are constantly inspected

"That reminds me that we had a little excitement the other day, when a pilot radioed in that one of his tires was flat. He must have got a puncture just as he took off. No one around here ever had seen a ship make a landing on a flat tire, so we didn't know what was likely to happen. I loaded a half dozen men and a jack into a truck, and went over to the landing field just before he was due.

"He came in over the field, put his plane down nice and easy, and taxied along with all the weight on his good tire. His passengers didn't even feel a bump. As soon as the ship stopped rolling we got a jack under her, and had the flat tire off and another one on almost as soon as the people in the cabin realized that anything out of the ordinary had happened.

"That experience taught us that landing on a flat tire doesn't mean a call for an ambulance. Everyone in this business always is learning something from experience. That's one of the reasons why flying is getting safer all the time.

"A long time ago, when I had just graduated to an airplane hangar from an automobile factory, experience taught me a lesson that I've never forgotten. That lesson was never, under any circumstances, to leave a job on a ship unfinished.

"Late one afternoon I was doing some work on a mail plane. I had just twisted a nut on a bolt with my fingers, and was about to put in a cotter pin and tighten the nut with my end wrench, when the boss called me. I stuck the wrench in my hip pocket, and went into his office.

"He kept me there for over an hour talking about some work, and when I got out in the hangar again it was long past quitting time. So, never thinking about the nut I hadn't tightened, I put on my coat and went home.

"The next morning, when I picked up my trousers, the end wrench fell out of the pocket. The instant it hit the floor, I remembered about that untightened nut. It was a vitally important nut, and I knew that if it had come off while the ship was in the air, there probably was a washed-out plane and a dead pilot somewhere along the route between New York and Washington. And that it was my fault!

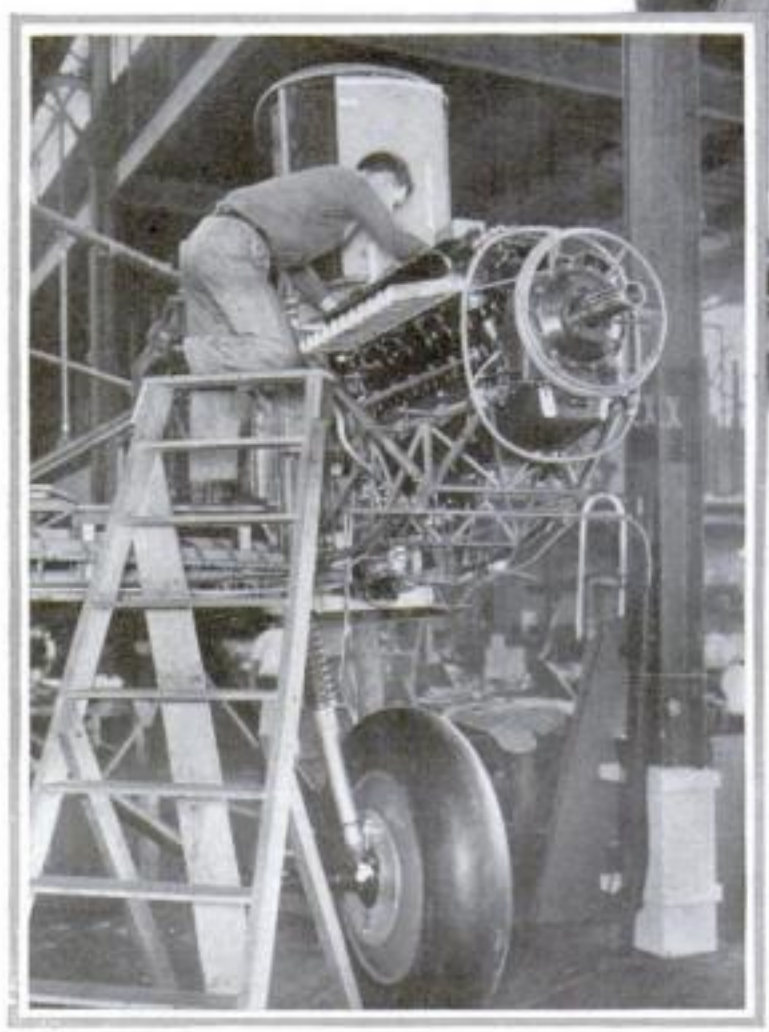
"I hurried down to the hangar and telephoned to a fellow I knew at the Washington field. Sure, he said, the ship had got there all right.

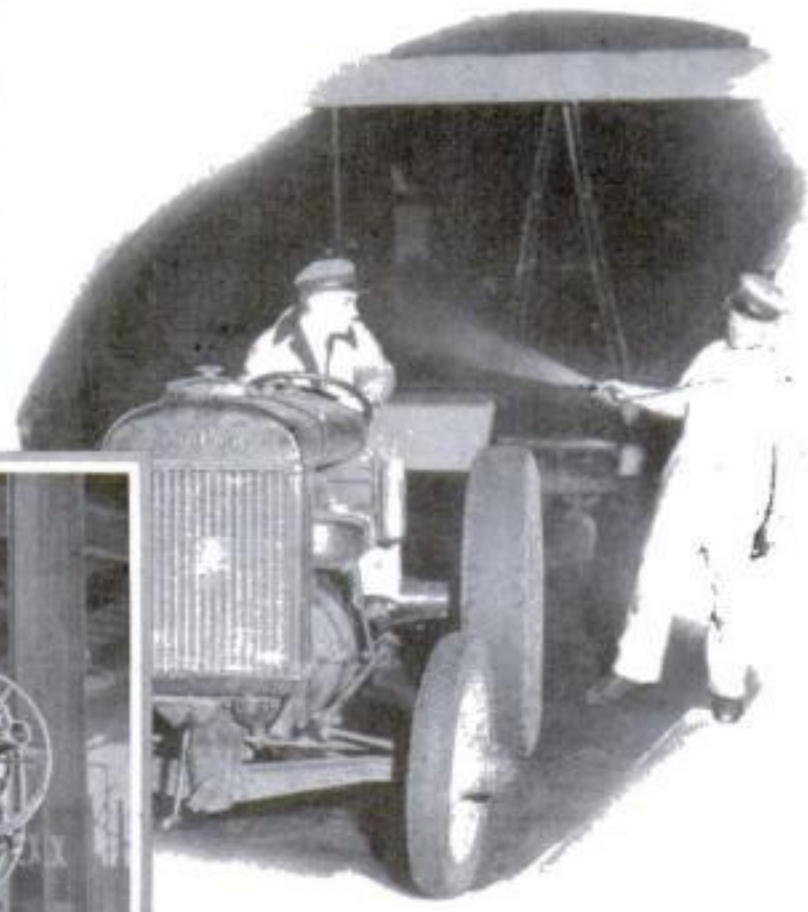
"As soon as I could say anything, I asked him to go out and fix that nut. And right then and there I made a rule for myself that I've never broken—never, under any circumstances, to leave a job on a ship unfinished. If I'd started doing something on a plane, and the president of the company called me, I'd clean up that job before I left it—even if I got fired for doing it!"

Outside, the roar of the Condor's three motors had ceased, and the chugging tractor was towing the big ship tail first into the hangar, a piece of navigation complicated by the fact that the plane had a wing spread of eighty-seven feet and that there were four like it already in the hangar.

Inspectors and maintenance mechanics, flash lamps slung around their necks, went systematically to work on the liner. Gasoline, oil, and water were checked. The water pumps were greased. Engine mounts were inspected with minute care, a magnifying glass being brought into use when one of the inspectors detected something that looked like, but wasn't, a crack. Men climbed over the ship carefully examining the wings, and the hinges, and surfaces of the controls.

The retractible landing gear fittings, the wheels, the brakes and the tires were inspected. Newly charged batteries were installed—all batteries are recharged after each flight. Starters and generators were checked. Spark plugs, magneto points, primers, and the ignition wires were inspected. All the ship's lights were checked. In the control cabin, every instrument was checked, and the radio set carefully tested. The duralumin propellers were looked over with care.





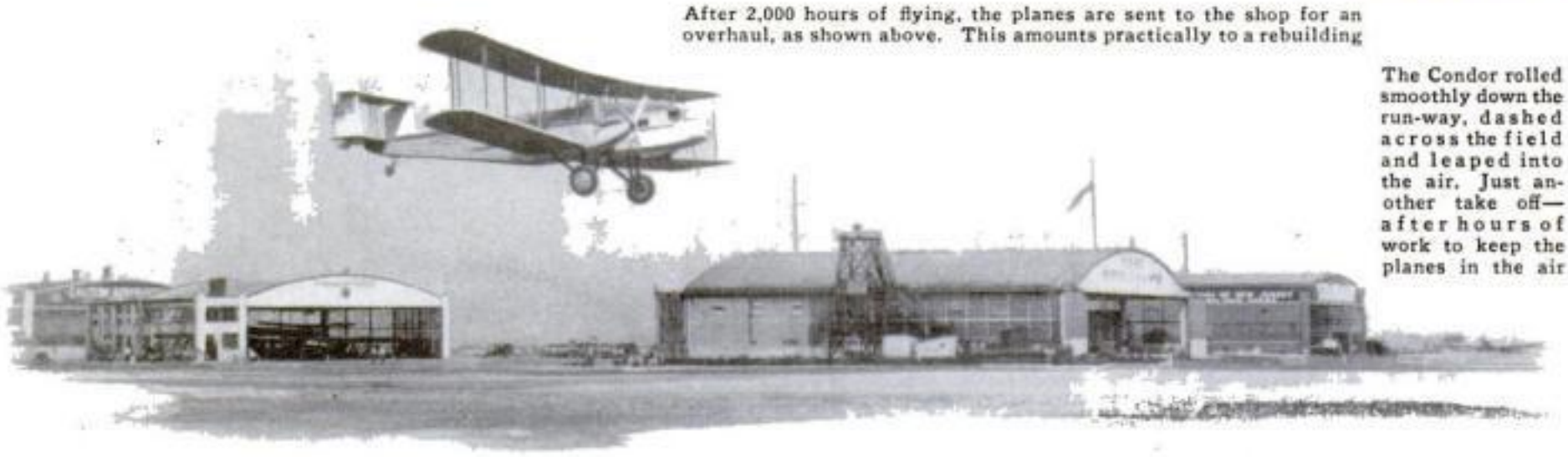
As soon as the passengers have alighted, a tractor tows the big plane to the hangar

Each of the more than thirty items listed on the inspection form is signed for by the inspector who checks it. When there is additional work to be done, the inspector makes a note of it, and the mechanic who does the job signs for it when it is completed.

So when the pilot takes over the ship for its next flight, he has a right to feel confident that it is airworthy in every respect.

Although *(Continued on page 88)*

After 2,000 hours of flying, the planes are sent to the shop for an overhaul, as shown above. This amounts practically to a rebuilding



The Condor rolled smoothly down the run-way, dashed across the field and leaped into the air. Just another take off—after hours of work to keep the planes in the air

New Television System

ADOPTS UNIQUE METHODS

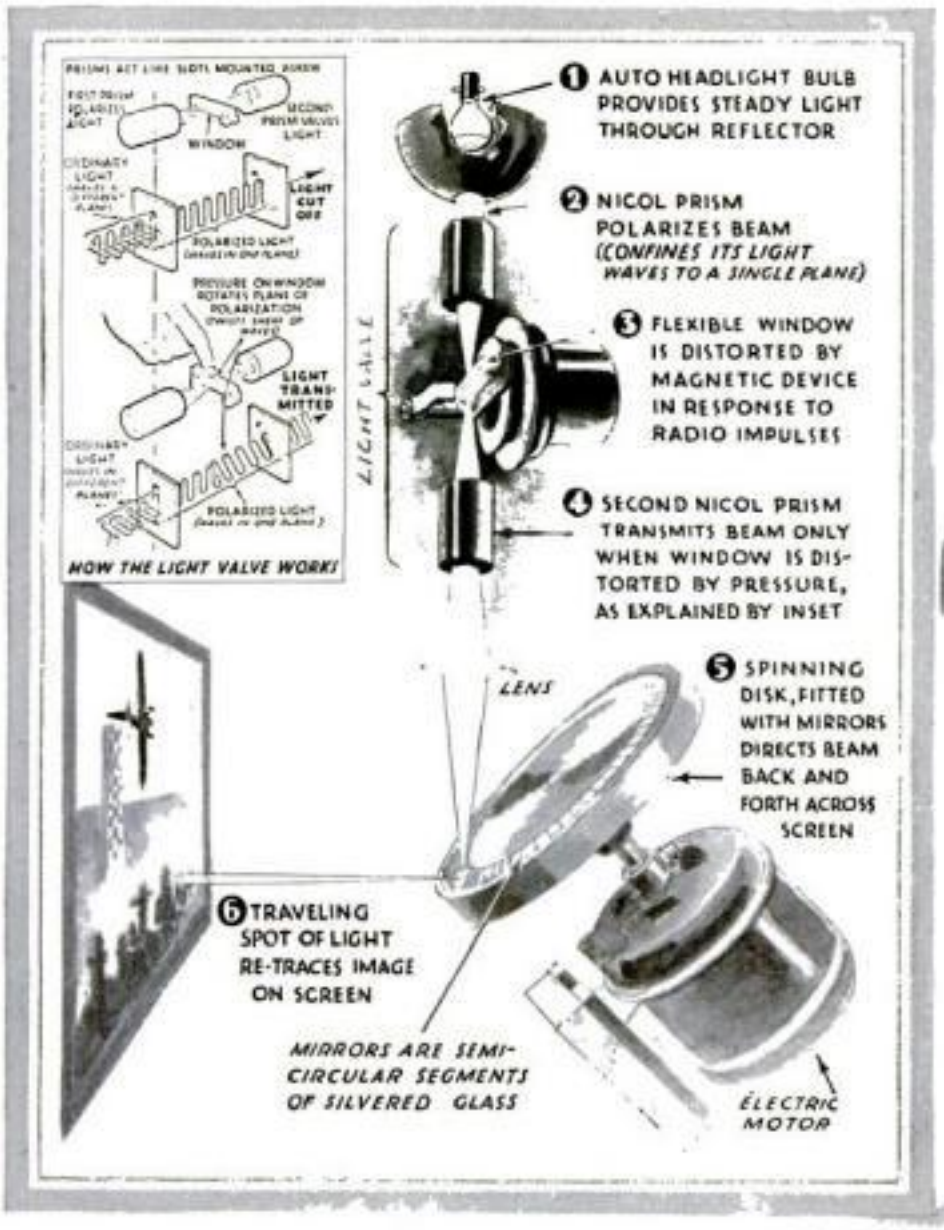
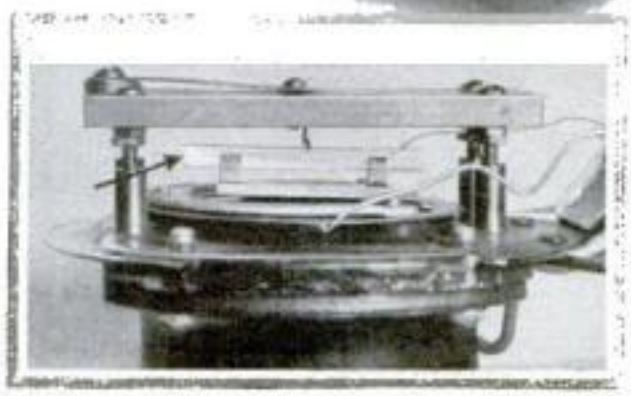


Illustration above shows mechanism and manner of operating the new television system designed by a New York inventor

Units of the new television receiver are shown in photo, being assembled for laboratory test. The small scanning disk is designed to project a large image



At left is shown the slab of glass-like material through which the light passes. It is mounted on a plunger that moves up forcing the slab against the stop seen in the center of the picture. Thus the thin slab is used as a light valve

A six-volt automobile bulb is used with reflectors that intensify the light many times

DESIGNED to throw images on a large screen, a television receiver based on new principles, is being developed by William H. Peck, New York inventor and former U. S. Navy optical expert. In each of the features common to all television receivers, a lamp to provide illumination, means for varying the brightness of the beam rapidly in response to radio impulses from the transmitting studio, and an optical system to swing the beam back and forth across the screen to build up images, the new set utilizes novel methods.

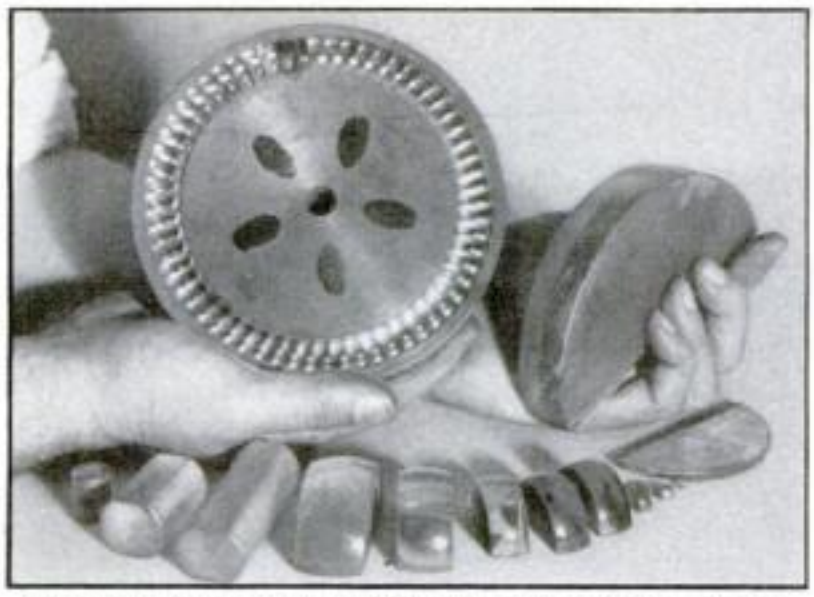
A standard auto-headlamp bulb is substituted for the neon tube of the usual television outfit in order to produce sizable black-and-white images, instead of small pinkish ones that must be magnified. The light of the headlamp bulb is augmented by a special reflector.

Since the headlight bulb cannot flicker with extreme rapidity, as a neon tube does, its beam is passed through a transparent window that is part of a mechanical light valve. Meanwhile a device resembling a dynamic loudspeaker, actuated by incoming radio impulses, subjects the window to fluctuating pressure. When the window is distorted by pressure, a bright spot appears on the screen. When the pressure is relaxed, the screen is darkened.

This is accomplished through the curious property of certain substances, such as glass and gelatin, of twisting a sheaf of polarized, or flattened, light waves, when distorted by pressure. Probably this is the first time an inventor has harnessed, for popular use, this obscure laboratory phenomenon.

To direct the light beam back and forth across the screen of the receiver, scanning its surface, Peck employs a mirror-studded disk whirled by an electric motor. The mirrors are smoothly cast, semicircular segments of glass, silvered on the base, and mounted in a circle in such a way that the points of reflection are arranged in a spiral pattern.

This results in such high optical efficiency, according to the inventor, that the new television receiver will throw so brilliant an image on its screen that the pictures may be watched in a fully illuminated room.

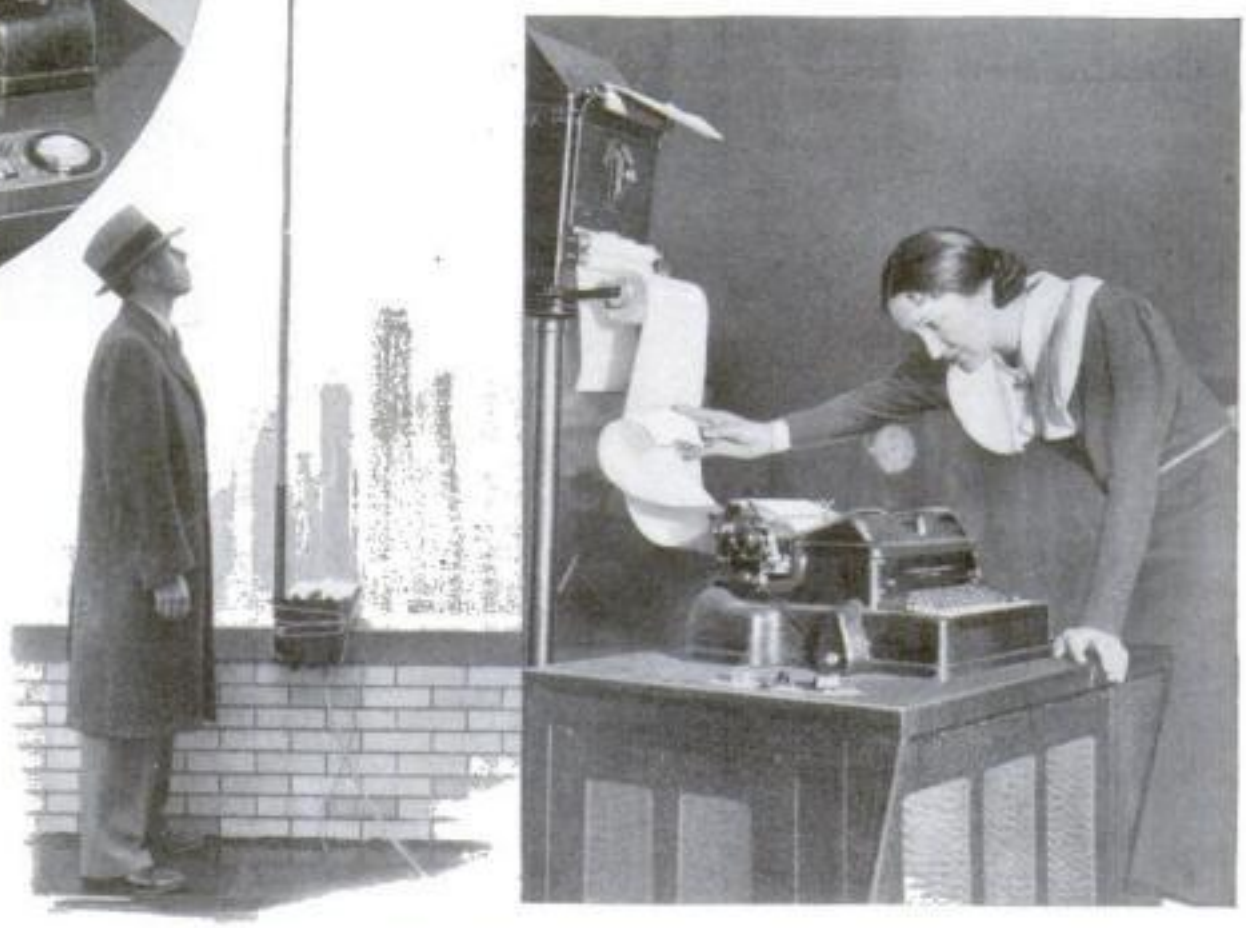


Close-up of the scanning disk and several of the mirrors

RADIO TYPEWRITER USES MICRO WAVES

TYPEWRITING by radio, on the newly exploited ultra-short waves, is a new method of communication heralded by apparatus already being developed by a New York firm. By this means, a stenographer at the central office of a large industrial concern could transmit messages simultaneously to other parts of the plant or to branch plants in distant cities. Thus copies of business documents are instantly available wherever desired. Other applications are foreseen; for example, a reporter sitting at the transmitting typewriter could write on ten or more typewriters situated at distant points; while a state or city police headquarters could similarly communicate with police outposts or cruising radio cars.

Above, radio typewriter, transmitting a message by ultra-short radio waves. At the right, the aluminum rod that serves as its antenna



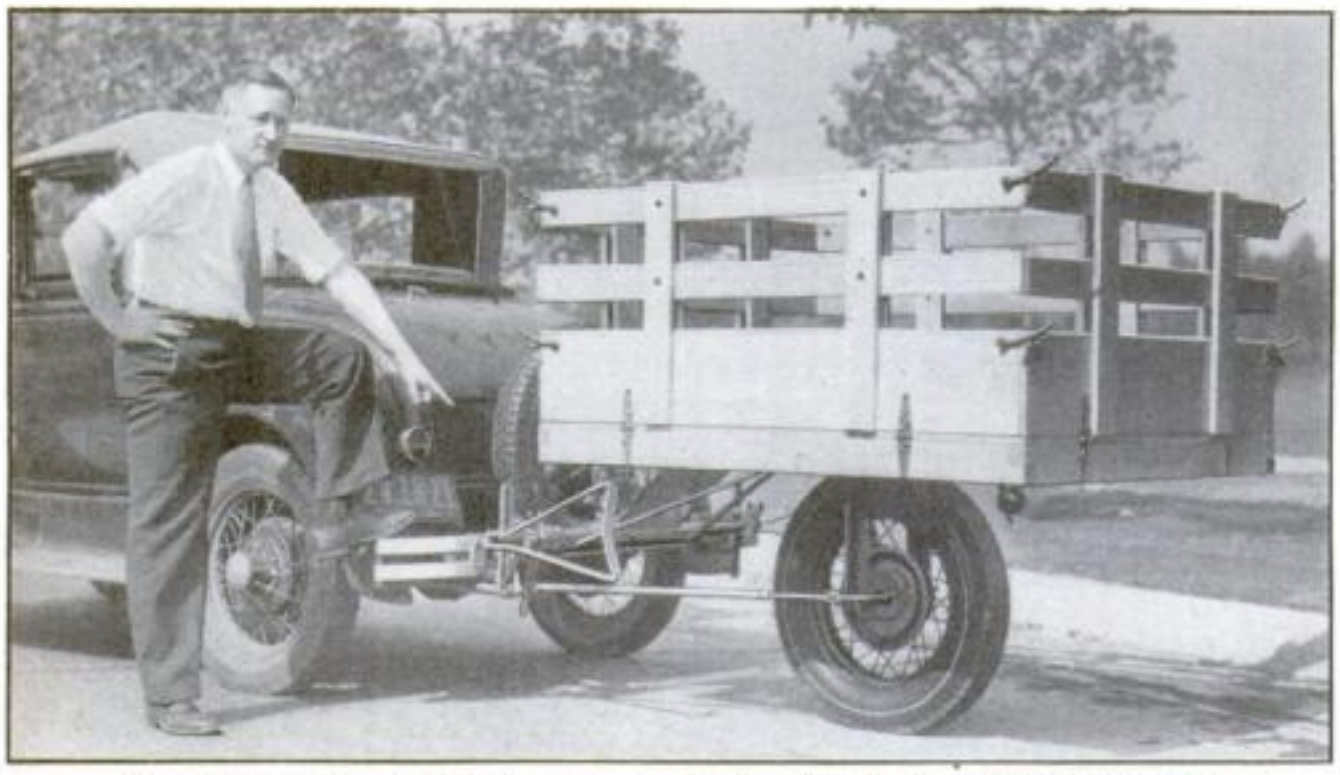
Here is the machine, similar to the transmitting machine at upper left, that receives the messages sent by micro radio waves. It operates at any distance from sending station

BULLET FROM EACH GUN SOLD TO GO TO POLICE

FINGERPRINTING every revolver was recently suggested by Dr. William B. Rayton before a meeting of the American Prison Association. According to his plan, a bullet would be fired through every revolver after manufacture and filed with the police. Bullets in murder cases, which had been fired from unknown guns, could be compared by ballistics experts to these test bullets, thus tracing them back to the guns which figured in the crime.

ONE-WHEEL TRAILER STEERS WITH CAR

RIDING on a single wheel, that is steered in unison with the front wheels of the car to which it is attached, a trailer devised by a Los Angeles, Calif., inventor permits a driver to back or turn at will without thought of the load behind. The trailer couples to the automobile's rear bumper, and tie-rods connect its wheel to the car's steering mechanism. It is easily attached to any type of machine and can be readily disconnected.



The single wheel on this trailer connects directly with the steering gear of the car so that turning the steering wheel guides the trailer in backing or turning the auto

INK PUMP IS PART OF BOTTLE CAP

FILLING a drawing pen or an artist's brush is simplified by a patented automatic bottle cap that pumps ink out of the bottle into a tiny reservoir, where it is transferred to the pen or brush. Excess ink drains back into the bottle. The operation of filling requires but a second or two, and is performed by pressing a plunger on the cap. In addition to simplifying the filling process, the pump saves ink by preventing evaporation and spilling and also, there is less chance for the pen to gum up.

Above, sailboat and motor hulls made of paper by new process. At upper right, assembling a paper hull. At right, paper sailboat in the water

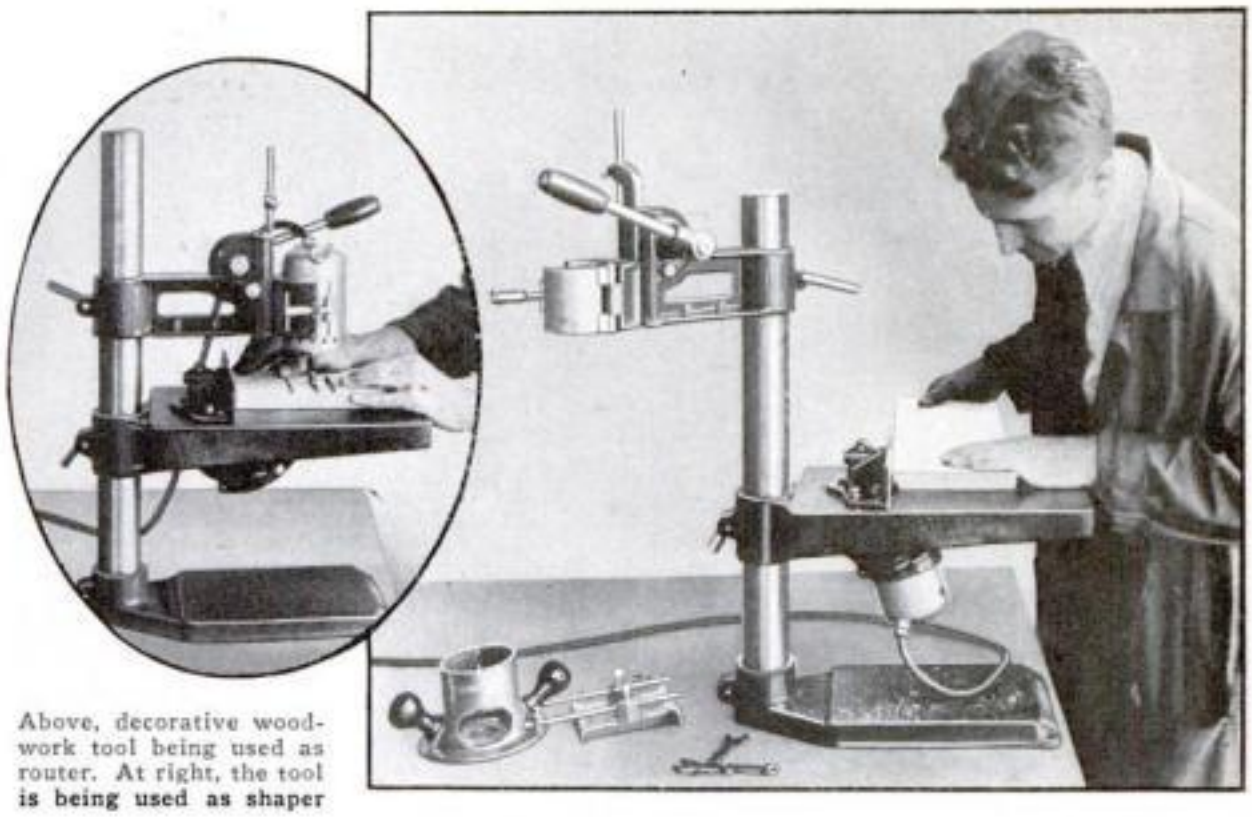
PAPER SHIPS SAIL WELL IN WATER

SHIP models of paper, that sail like real vessels, are the invention of L. P. Hall, Jr., Morristown, N. J., engineer, who has applied for a patent on his method of construction. The material used is a standard grade of heavy jute paper, or tag board, which is die-cut in the desired shapes. These are supplied in kits for home model makers, who assemble the parts with glue. The hull is treated with a waterproofing solution, applied with a brush, while the sails are also waterproofed by applying a thin coating of the same solution with a brush on each side. When completely assembled, the model ship presents an extremely light and rigid construction, due to the stiffening effect of the waterproofing material. Its paperlike qualities disappear, and its characteristics of buoyance probably resemble those of a real boat more than those of any other model type. Because of its lightness, the model shows great speed in the water. A typical model requires from six to eight hours to build.

LIPSTICK AND WATCH COMBINED IN ONE

WATCH and lipstick are combined in an unusual piece of craftwork produced by a Hollywood, Calif., jeweler. Each time the user of this two-in-one accessory reaches for her make-up, as she prepares to keep an appointment, the hands on the diminutive dial remind her how many minutes she has at her disposal. Originally created as an accessory for use in a movie production, the lipstick watch is claimed by its designer to be a useful addition to any handbag.

A watch is set in this new lipstick holder so that the user can readily tell the time



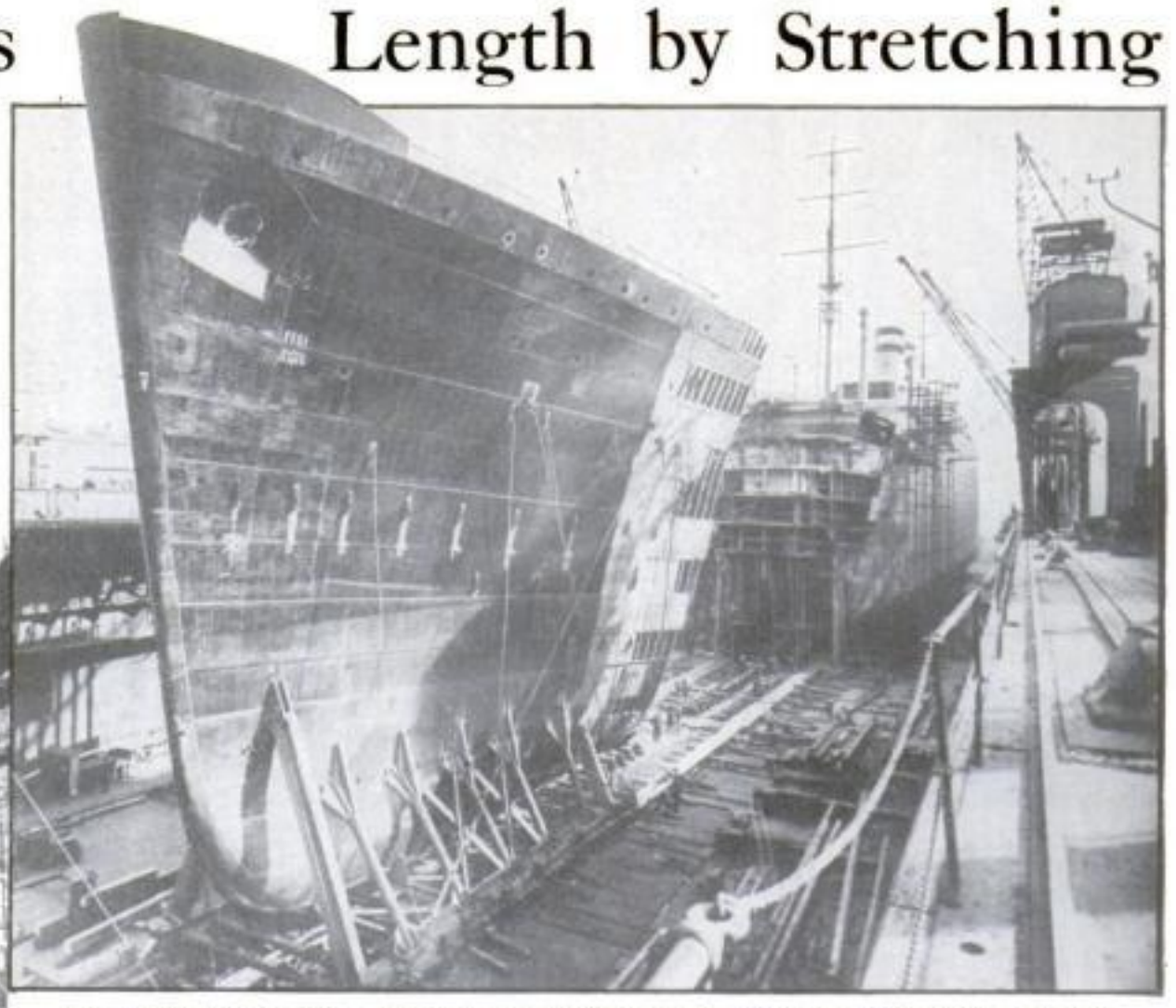
Above, decorative woodwork tool being used as router. At right, the tool is being used as shaper

TOOL AIDS WOODWORK IN HOME SHOP

DECORATIVE woodworking that has hitherto been beyond the reach of the average home-workshop enthusiast is made possible by a new electric router and shaper, recently placed on the market. With its aid, the amateur craftsman finds it easy to embellish his handiwork with delicate inlays, beading, veining, and dovetail or mortise-and-tenon joints, as well as to perform thousands of other woodworking operations. An interchangeable power unit makes possible the purchase of either a hand router, bench router, or bench shaper, and the later addition of the other units. The shaper has a patented tilting motor unit holder that not only makes possible the use of small-diameter cutters for molding cuts but also makes possible the cutting of almost any contour with a limited number of cutters. With only four cutters it is estimated that 600 different moldings can be made. The drive from the 110-volt, universal electric motor is direct.

Increase Liner's Length by Stretching

STRETCHING a transatlantic liner to make it forty feet longer is an unusual engineering operation in progress at Hamburg, Germany, where the steamship *Hamburg* is being enlarged to provide additional passenger and cargo space. Three other vessels of the line are soon to be altered similarly. To do this, the ship is placed in dry dock, where its bow is cut away. A longer bow is then electrically welded in its place. Joining the two parts involves remodeling the bulkheads.

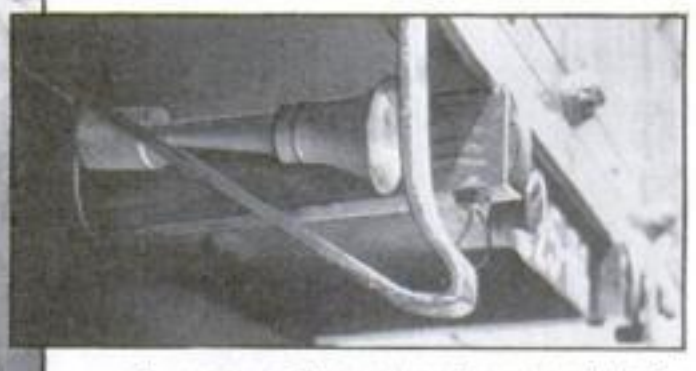


Liner *Hamburg*, in the background, with its old hull cut away and ready to have the new and longer hull, seen in the foreground, fitted and then accurately welded to decks and plates

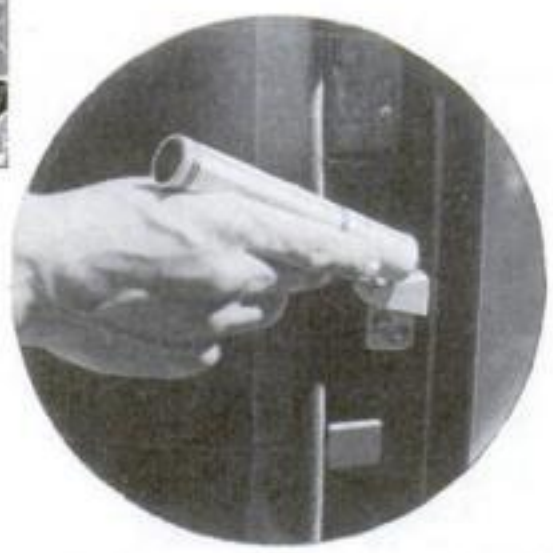
View of dry dock in which new hull is being built to make ocean liner forty feet longer

LOUDSPEAKER IN TRUCK WARNS OF CAR BEHIND

FOR DRIVERS of heavy trucks with noisy loads, who sometimes are unintentional road hogs because of inability to hear the honking of a car behind, a French inventor has designed a loudspeaker telephone system. A transmitter at the rear of the truck picks up the sound of an oncoming car's horn, and wires convey it to a loudspeaker beside the driver. Hearing the blast of a horn at his ear, the driver knows there is a car in back of him and pulls over to the side of the road.



Above, transmitter mounted on rear of truck to pick up the sound of an oncoming car. Left, loudspeaker that is wired to the transmitter



New stainless lubricant, in the form of a stick, is being applied to a sticky car door

GUARDS ON MOTOR BIKE PROTECT RIDER'S LEGS

TO PROTECT a motorcyclist's legs from injury by being brushed by other vehicles, or in case of a spill, a new cycle is equipped with safety guards in the form of wing-like extensions of heavy tubing, as shown in the illustration at right. Possible damage to the machine is also minimized by the new fenders.

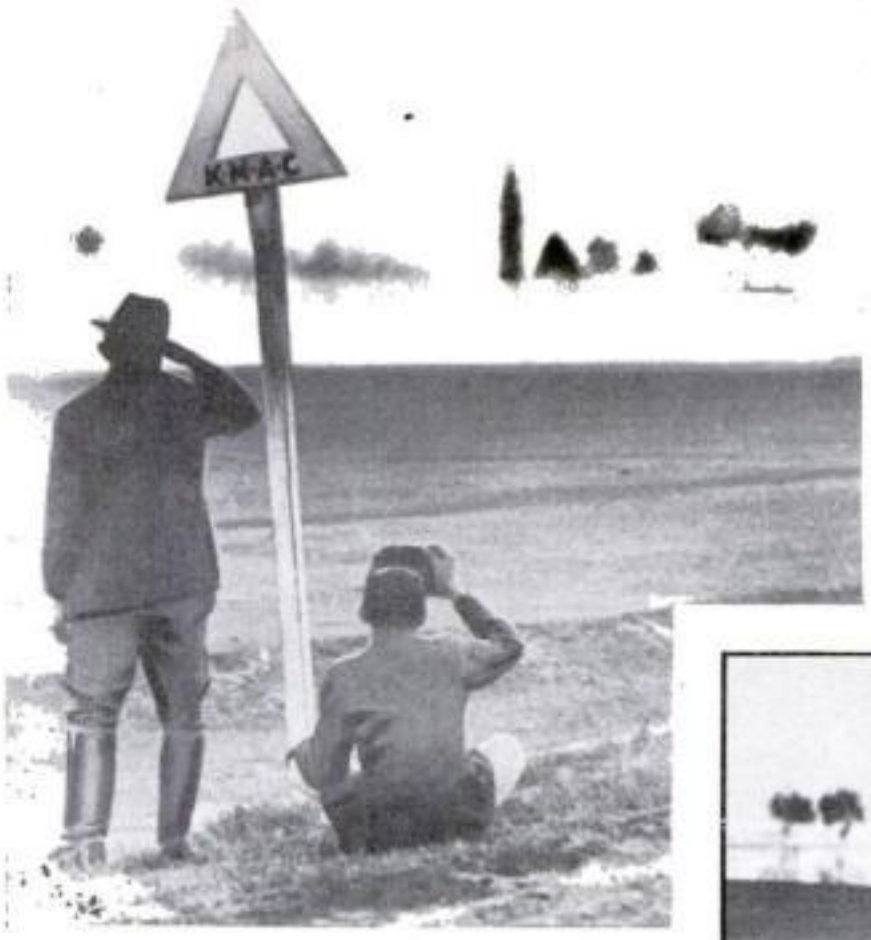
GREASE FOR CAR DOOR NOW COMES IN STICK FORM

FOR curing sticky automobile doors and squeaking hoods a new lubricant in handy stick form has been placed on the market. The stick is forced from its metal case by thumb pressure at the bottom and is simply rubbed against a fitting to lubricate it. According to the maker, the lubricant is stainless and will not soil clothes with which it comes in contact. A smaller-sized stick, resembling a crayon, is also available for home use.

RARE PHOTOS SHOW

How Mirage Paints Images on Sky

Natural Phenomenon Recorded by Camera on Hungarian Plain



High above the horizon line, which is near the center of the picture, the observers see a landscape apparently resting on air

Thrown into the sky by deflected rays of light, the images in the background of this remarkable picture were seen by the men in the foreground, as the camera caught the unusual scene

REMARKABLE photographs of mirages, believed virtually the first of their kind ever made, have just been obtained by an enterprising photographer at the town of Debreczen, some distance east of Budapest, Hungary. The views, of which three of the most striking are reproduced on this page, may prove of considerable scientific value in studying one of the strangest of nature's phenomena. Few places in the world are better suited to the observation of mirages than this Hungarian lowland, an almost level plain rimmed by higher land. Strange apparitions appear above the horizon as the sun breaks through a morning mist. Greatly magnified, church steeples and houses of faraway villages appear in the sky high above the horizon. Even distant carriages and railroad trains, normally invisible, come into view as fantastic specters. Sometimes the visions appear half submerged by water, as in a flood. The explanation of these strange images is to be found in the fact that layers of hot and cold air, having different refracting or light-bending powers, may deflect rays of light reaching an observer from a distant object and give a false impression of its distance and size. The particular effect produced depends on the special atmospheric conditions as illustrated in the two accompanying diagrams. In some cases the air layers act like a telescope lens and enlarge as well as elevate distant objects. Both of these very remarkable mirage-creating conditions are clearly explained in the two illustrations that are reproduced at the right.

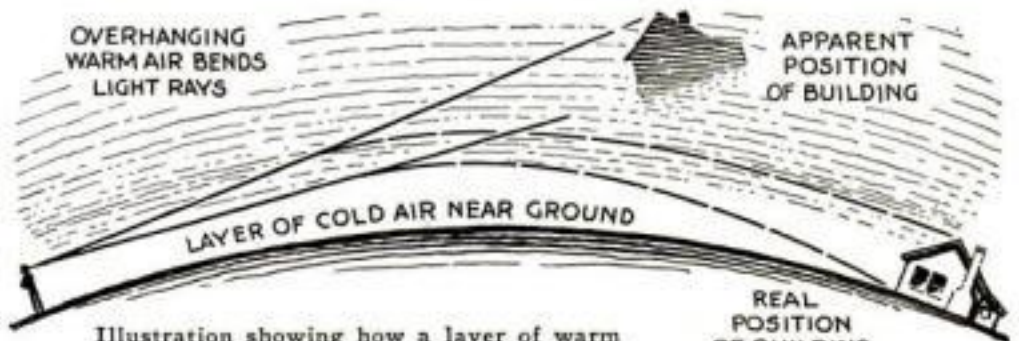


Illustration showing how a layer of warm air bends the light rays so that the image of an invisible object is seen in the sky

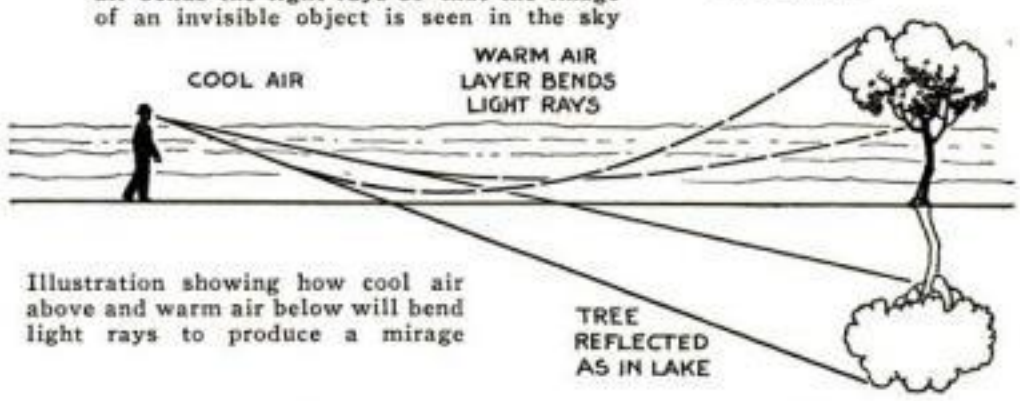
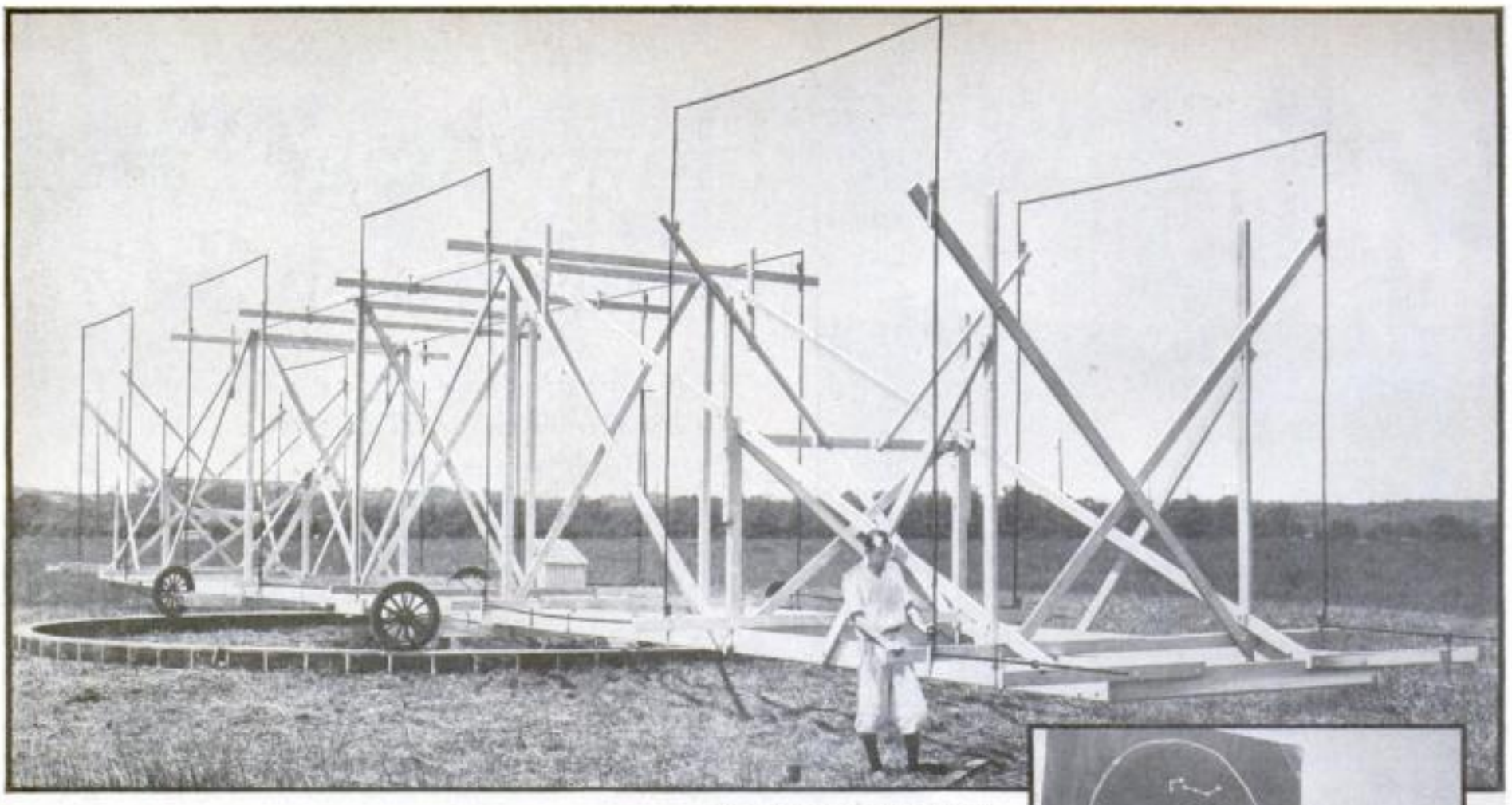


Illustration showing how cool air above and warm air below will bend light rays to produce a mirage

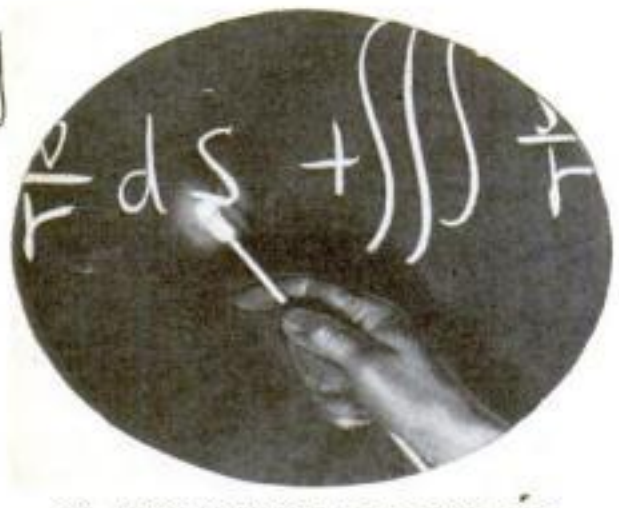
Many miles away, this train was seen rushing along, leaving a trail of smoke against the sky. In reality it was far below the horizon



The revolving antenna, above, established the Milky Way as the source of mysterious radio waves. Right, an instrument used in studying signals from outer space

Milky Way Found Source of Cosmic Radio Waves

MYSTERIOUS radio signals that reach the earth from the Milky Way are being studied by Dr. K. G. Jansky, Bell Telephone Laboratories engineer, with the aid of an unusual revolving antenna at Holmdel, N. J. First discovered a few months ago, they have been identified as of 14.6 meters wave length, and can be picked up in a suitable receiver as a cosmic hiss which was recently carried by land wires to an audience in the American Museum of Natural History in New York. The direction from which they come has been investigated with the aerial, which is rotated by a synchronous motor at the rate of one revolution in twenty minutes, and has been found to coincide with the Milky Way. This can be interpreted to mean that stars which are sources of radio frequencies are scattered all through the galaxy. This, in turn, suggests that under these circumstances the maximum strength of these waves would seem to come from the center of gravity of the galaxy itself. However, the actual cause of the waves remains a mystery. It is this mystery that is to be investigated with the aid of new instruments. With these it is hoped to establish definitely whether the waves travel direct from the stars to the earth, or are generated near the earth's atmosphere by bombardments of cosmic energy.

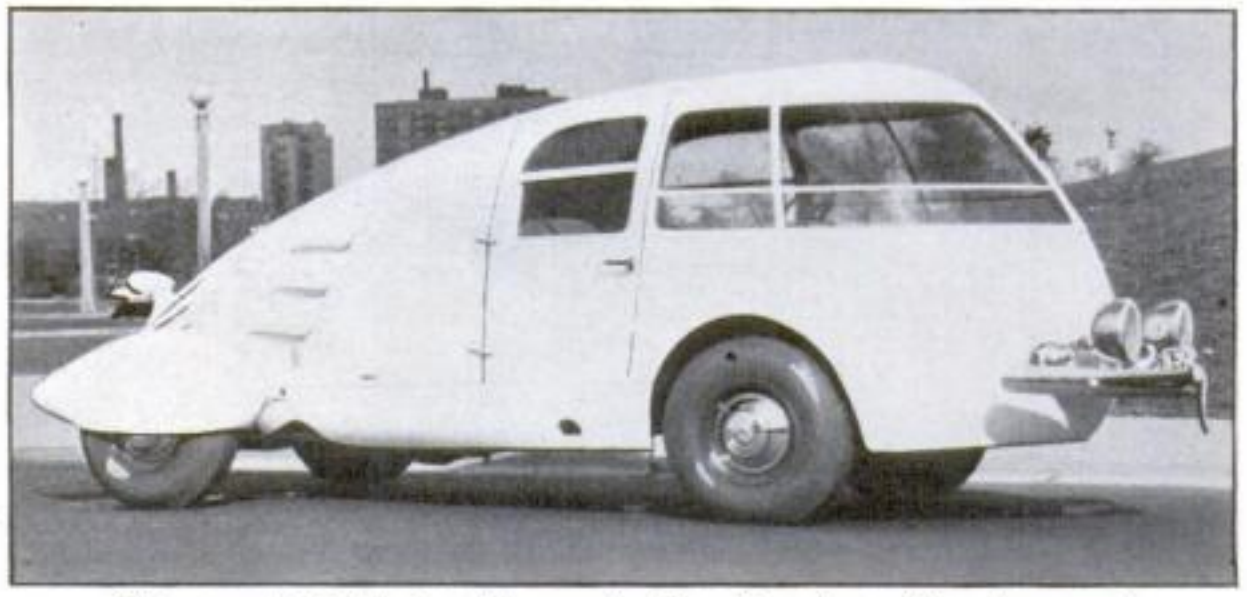


FLASH-LIGHT POINTER FOR USE OF LECTURER

TO AID lecturers in drawing attention to figures on a blackboard, a flash-light pointer has been devised by Westinghouse engineers. A bulb at its tip is supplied with current from a battery within the hollow steel pole, and is illuminated by pressing a switch in the handle. The flash-light is said to help focus the eyes on a particular point.

NEW STREAMLINED CAR HAS FRONT DRIVE

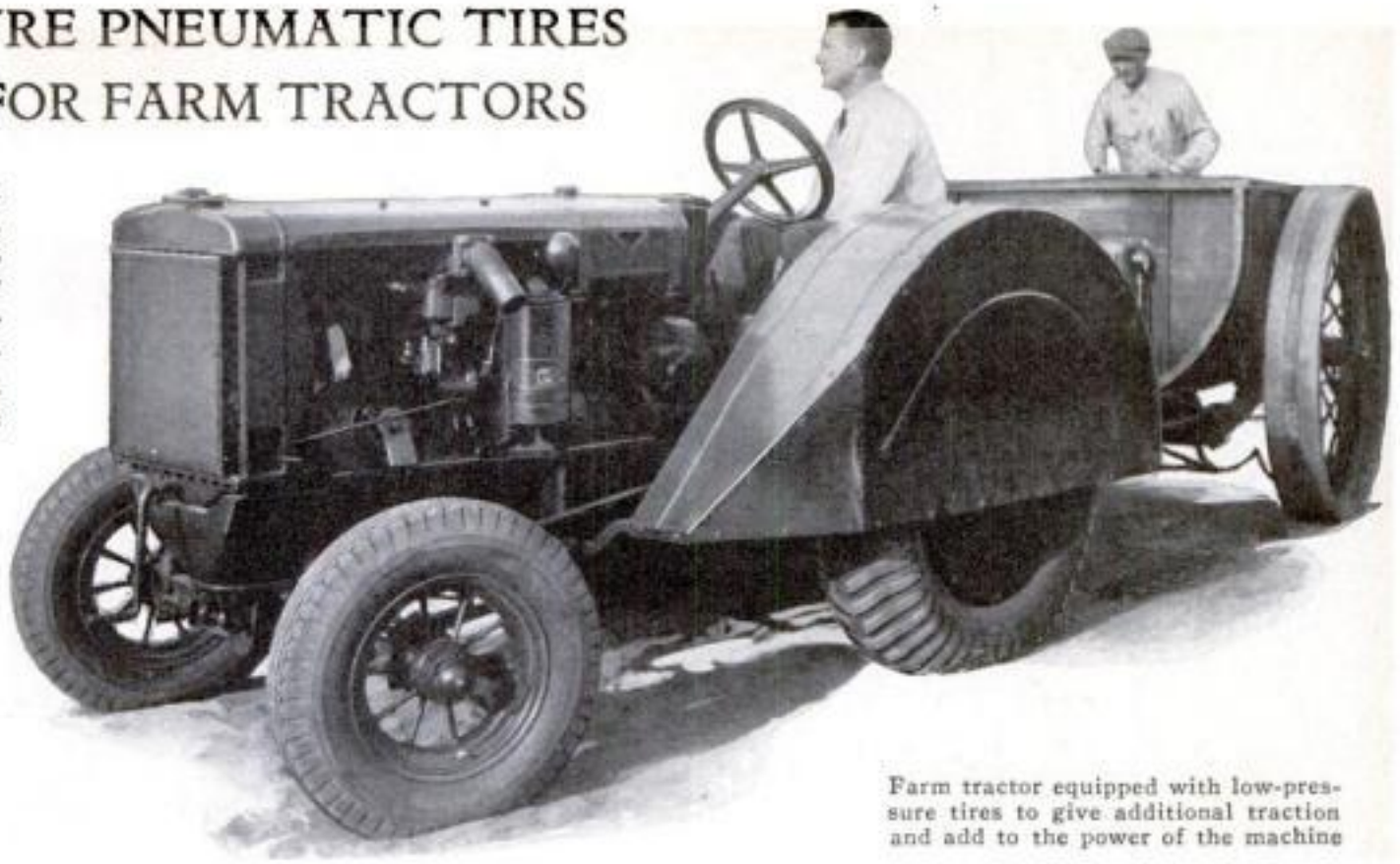
COMPLETELY streamlined, a new teardrop car, demonstrated in Chicago, is reported capable of ninety miles an hour. In test runs at a mile a minute, the normal tendency to swerve on passing large trucks because of the vacuum produced, was declared absent. The motor, at rear, drives the car through the front axle.



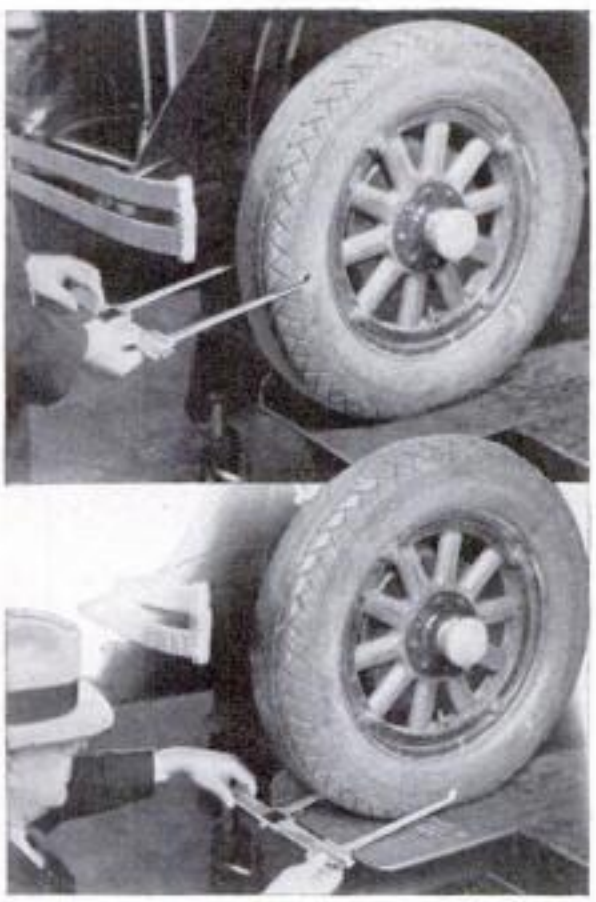
Fully streamlined, this front-drive car is said to hit a ninety-mile an hour speed

LOW-PRESSURE PNEUMATIC TIRES DESIGNED FOR FARM TRACTORS

DESIGNED especially to meet the requirements of the farm, low-pressure pneumatic tires for tractors have recently been introduced. A tractor fitted with these tires can operate not only in the field but also on the road, around the barnyard, or in any of the buildings. The special rubber compound used is designed to resist abrasion, cuts, and snags incident to field work. Weights are provided to be added to the wheels for service where heavy loads cause a tendency to slip. The tubes have offset valves inserted through the rim's side.



Farm tractor equipped with low-pressure tires to give additional traction and add to the power of the machine

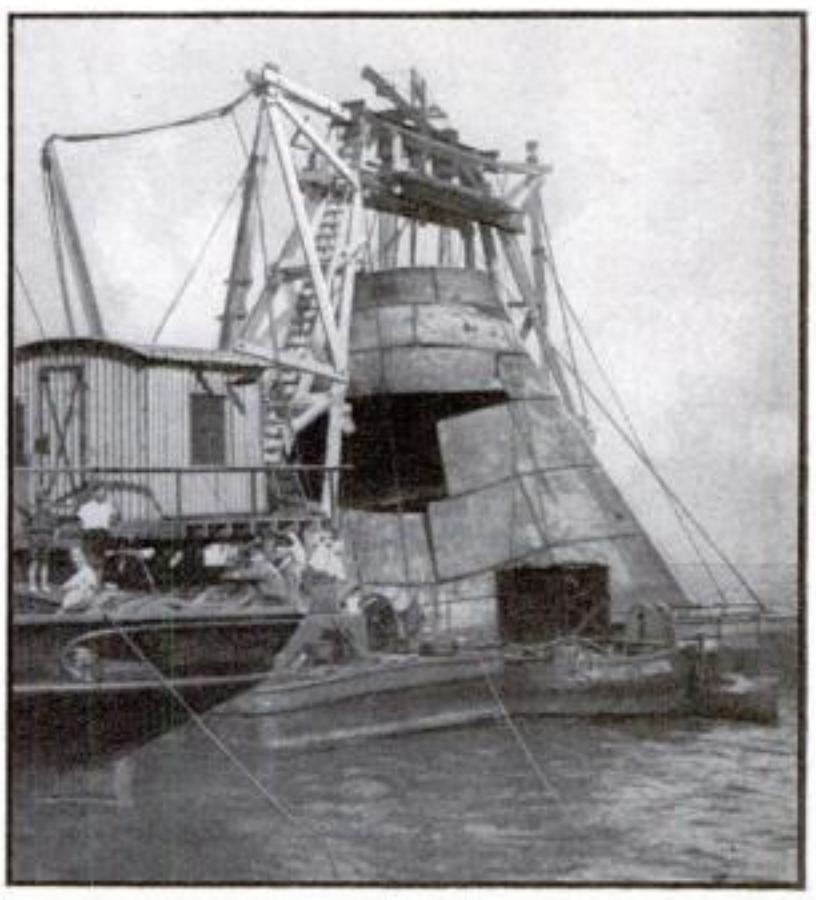


NEW GAGE MEASURES BULGE OF AUTO TIRES

MEASURING the bulge of an automobile tire, instead of the pounds' pressure of air it contains, is a new guide to tire inflation introduced by a bulge gage just placed on the market. The makers contend that it is the actual amount of deflection of a tire under its load that determines its life and its easy-riding qualities, and that this bulge should be equal for all the tires on the car, while the air pressure may properly vary according to the load on each wheel. Used like a pair of calipers, as shown in the illustrations above, the new gage is pre-set for a standard deflection and serves as a ready check while the tires are being inflated. A standard bulge line is indicated on the gage and it is this mark that guides you in checking the bulge of the tires, the first measurement being taken at the height of the wheel's hub.

WORLD WAR MINE HALTS SALVAGE WORK

EFFORTS to recover $10,000,000 in gold from the sunken frigate *Lutine* off the Dutch coast were halted abruptly, the other day, by one of the oddest of marine accidents. Interrupted by heavy seas, salvagers were about to redescend to the conical caisson in which they were clearing sand from the derelict (P.S.M., Oct., '33, p. 16), when a mysterious explosion rocked their rig. The cone was hauled up and found torn apart. Suspicions of sabotage by a disgruntled former employee or by rival treasure hunters vanished when an official investigation disclosed that a drifting mine, dating from the World War, had collided with the cone and exploded. The strange accident has postponed further salvage work until spring.



This steel cone, used in salvaging a fortune from the sea was ripped open by the explosion of a World War bomb

AUTOMATIC TYPEWRITER COPIES LETTER

AS MANY as 100 copies of a form letter, indistinguishable from an individual letter, are turned out by a new automatic typewriter, as quickly as the most skilled typist could write one. The letter is first typed on an appliance, at left in photo, that produces a master roll like that of a player piano. This roll is fed into the automatic typewriter, at right in photo, which operates by electricity. The typist has only to insert the address and salutation. The machine does the rest.

Near a girls' academy, a motorist got a flat tire and climbed out to examine it. As he did so, an arrow, shot from the archery range of the school, zipped by and took a bit out of his ear

Queer Things that happen to people in AUTOMOBILES

A runaway airplane hurdled a hedge and landed upside down on a parked machine. This is only one of the many strange accidents that occur to auto drivers

By Edwin Teale

•

LEAVING a thin trail of gasoline behind, an automobile with a leaking fuel tank rolled down the main street of a Massachusetts village. A few moments after it had passed, a smoker flipped a cigarette stub into the street. It touched off the inflammable trail. Fire raced along it, caught up with the car, ignited the fuel tank and sent the machine up in flames!

In California, not long ago, a highway expanded with the heat and hurled a motorist, machine and all, into the ditch. Under the sun's rays, the material had buckled at one of the tar-filled cracks, wrenching the car out of control.

For three days in succession, a Wisconsin motorist had trouble with his engine. He was staying at a summer camp, driving in to work each morning. On all three days, the cause of the trouble was the same: Squirrels had hidden acorns in his carburetor!

Thus, day by day, strange, unexpected, almost incredible experiences befall American motorists. Insurance company files, police blotters, and service station records are crammed with chronicles of weird accidents.

A frightened jackrabbit jumps through the windshield of a tourist's car in Kansas. A runaway airplane hurdles a hedge and lands upside down on a parked machine in Connecticut. A falling meteorite crashes through a radiator in Indiana. A driver's wooden leg catches on fire when two cars bump in Canada!

Twenty-five million automobiles ride the highways of North America. There are eight cars for every mile of road in the United States. Billions of miles are covered annually at high speeds. So anything can happen when Chance takes the wheel.

To the list of astonishing things that do happen, every state in the Union makes its contribution. Consider half a dozen such recent reports!

Georgia. Almost in the shadow of the Stone Mountain Memorial, a wagon carrying three men and pulled by two horses, was struck by a speeding auto. When the dust settled, one of the horses was sitting in the wagon, one of the men was perched on the back of the other horse, another of the men had been thrown through the side of a house and a buckle, flying from the broken harness, had struck a bystander and knocked him down a thirty-foot embankment. Even then, the excitement wasn't over. A spectator, running to help, tripped over a root and broke two ribs!

Arizona. During a heavy wind-storm at Phoenix, F. L. Lepur was afraid his new sedan would be damaged. He steered into the protection of the lee side of a building under construction. Hardly had he shut off the engine when down rained a quarter-ton of bricks. They smashed in the roof, hood and fenders of the car, causing the only damage done by the storm in the city.

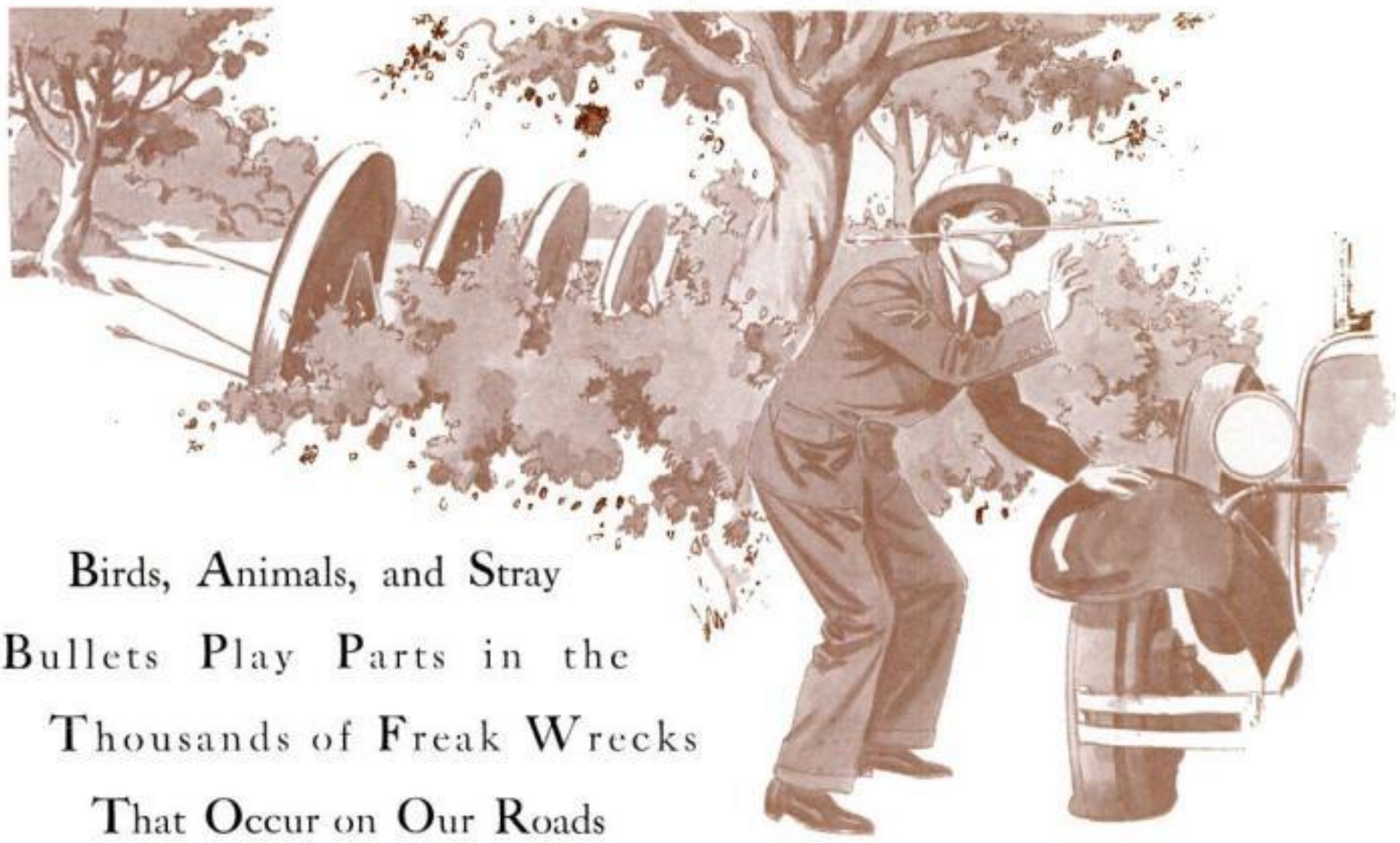
Wisconsin. Preparing to make a left turn, just outside of Platteville, James Rickard stuck out his hand. Whizzing up from the rear, a speeding machine struck it and broke his arm.

New York. Just as he passed a girls' academy, near Norfolk, Harold Green felt his machine bump along on a flat tire. Climbing out, he bent down to examine the wheel when a zipping arrow took a chunk out of his ear. It came from a nearby archery range where the girls were shooting at targets.

Florida. Accidentally leaving her car in gear, Mrs. Lucille McGirt got out to crank the motor. The car started, her dress caught in the crank, and the machine,

BULL DEFIES AN AUTO

At sight of a bull, a motorist stopped but the bull butted the machine back fifteen feet



Birds, Animals, and Stray Bullets Play Parts in the Thousands of Freak Wrecks That Occur on Our Roads

crashing through a wall, carried her into a doctor's office.

Illinois. When C. Miles MacDonald backed his car out of his Evanston garage and headed down the street, he was startled by bloodcurdling cries coming from in front of the dashboard. Jamming on his brakes, he leaped out to investigate. As he lifted the hood, out shot a gray alley cat which had been imprisoned within.

Often animals cause the freak accidents and unusual experiences which motorists meet on the public roads.

Three Pennsylvania deer hunters packed their equipment in a touring car and set out for a camp 200 miles from town. On the way, a deer charged out of the underbrush, ran point-blank into the speeding auto and all three hunters were killed.

Not far from Prince Fredericktown, Md., another motorist met a bull planted squarely in the middle of the road. He slowed down and stopped. The bull snorted, pawed the ground and charged, butting the auto fifteen feet backward. Before it could charge again, the astonished motorist wheeled his car around and stepped on the accelerator.

Another curious crash, caused by a twenty-pound snapping turtle, sent three cars to the garage for repairs at Pittsfield, Mass., not long ago.

George B. Maddocks was returning from a fishing trip with the turtle tied up in the back of his car. On the outskirts of the city, it worked itself free, crept over into the front seat, opened its beak and snapped at the driver's leg. With a yelp of pain, Maddocks tried to pry the turtle loose and in so doing lost control of the machine and struck two other cars.

Even more surprised was Henry Liggett, of Phoenix, Ariz., when two battling owls gave him the scare of his life. Shortly after dusk, he was trying out his new

CAR LOOPS THE LOOP. A taxi, skidding off a bridge, turned a complete somersault in the air and landed, right side up, on the ground forty feet below without hurting either the driver or his passenger

roadster when, like a bombshell, the windshield burst into fragments and he was showered with glass, feathers, and fur. As soon as he could stop, he found in the seat beside him two huge owls locked in a death struggle with a rabbit clutched between them. Fighting over their prey, they had flown into the windshield.

Then there is the bizarre case of "Wizard" Smith, an Australian racing driver who was almost killed through being struck by a feather!

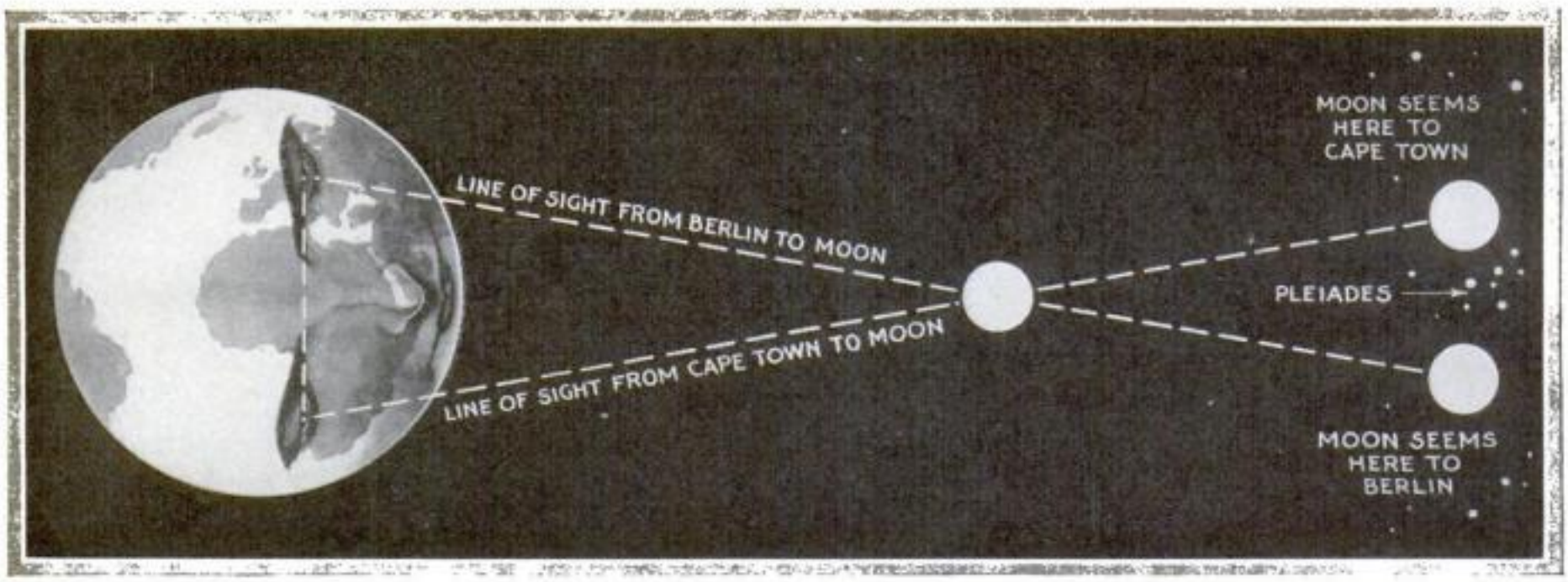
In 1930, Smith was making a speed trial over the hard-packed stretch at "Ninety Mile Beach." His low-slung racer was burning up the sand at 148 miles an hour when it struck seven sea-birds. Feathers flew over the windshield. One struck Smith in the face with an impact which nearly blinded him and it was only by a hair's breadth that he avoided a fatal crash.

A few minutes after eleven o'clock, one August morning, a Missouri farmer and his wife were bowling along a highway near Odessa on their way to town. Suddenly, the car careened across the road, sidewiped another machine, and piled up in the ditch. A blinding, stinging cloud of bees, swirling madly after their queen, had entered the open car and swarmed on the face of the driver! Naturally, he lost control of the machine.

A second curious accident in which bees played a part occurred near Tulare, Calif. Two colliding machines were only slightly damaged and no one was hurt. Yet traffic along the highway was tied up completely for a whole afternoon. During the rest of the day, traffic officers were busy warning motorists to detour until sundown when the angry insects returned to their hives on one of the colliding machines.

The thought that he had been stung by a bee was the first that occurred to Thomas Pendergast when he felt a sharp pain in his nose as he drove down a street in Brooklyn, N. Y. Then his nose began to bleed and would not stop. At a hospital, a doctor was examining his nose when Pendergast coughed up a bullet. Its force practically spent, the lead had entered his nose and had been breathed back into his throat.

Another Brooklyn bullet produced a fantastic climax to a two-mile race with a bandit car. After the pursuing officer had fired a shot *(Continued on page 100)*



If a man's head were as large as the earth, so that one eye was at Berlin and the other at Cape Town, he could, by closing first one eye and then the other, see the moon at different places among the stars, as is indicated in the illustration. This apparent shift of position is called "parallax" and astronomers use it to find distances. See photos at bottom of page

How Astronomers Find

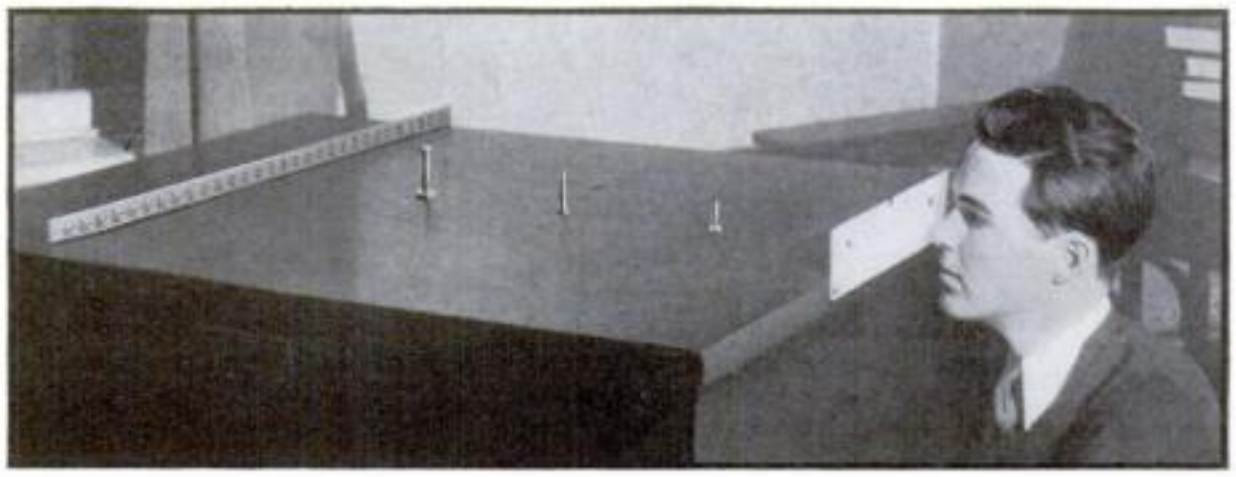
Star Distances *and* Sizes

WHEN you read that the moon is 238,857 miles from the earth, you naturally wonder how astronomers are able to measure accurately such a vast distance across empty space—more than nine and a half times the mileage round the earth at the equator.

Your wonder about the process of measurement grows when you learn that the nearest of the fixed stars, Alpha Centauri, is 25,600,000,000,000 miles away, or 275,000 times the distance of the earth from the sun!

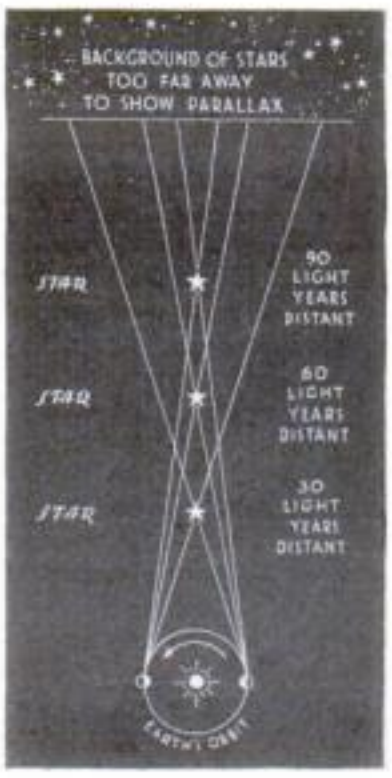
Yet the method astronomers use to measure these tremendous distances is really simple, and can be illustrated by merely opening and closing the eyes alternately.

As I look out of the window over my desk I see beyond the curtain cord, a house across the street. When I close my left eye, the curtain cord apparently hangs to the left of a certain point. When I open the left eye and close the right, the cord seems to jump across to the right side of the same point. This apparent change in the position of an object when viewed



How Distance Decreases a Star's Parallax

A yardstick is set up on a table to which a card, with two holes in it and a notch midway between them, has been attached as is shown above. Set up a rivet, a screw, and a bolt at five, ten, and fifteen inches, respectively, from the card. Sight through first one hole and then the other and write down the positions of rivet, screw, and bolt as read on the yardstick. You will find that the difference in rivet readings will be twice that of the screw and three times that of the bolt. This proves that the parallax decreases as star's distance from observer increases



Looking out of the window with the left eye closed, the curtain cord will appear as in the picture at the right. With right eye closed cord jumps to the right

In this experiment, stand a few feet back from the window. Closing first one eye and then the other, now displaces the cord half as much as in the first test

By

GAYLORD JOHNSON

from a different standpoint is called "parallax."

If I get up from my desk chair, move back a few feet into the room and try the experiment over again, there is an important change in what happens. Alternately opening and closing my eyes then causes the cord to move only about *half* the distance it did before.

The farther I move back from the window, the smaller the distance the cord seems to move across the background when I open one eye at a time.

This simple experiment gives the principle astronomers use in determining the distances of the moon, sun, and stars. Let us see how it is applied practically in finding the distance of the moon.

Imagine a man of such huge size that his head is as large as the earth. Then think of his two eyes as two observatories. One of the observatories is located at Berlin, Germany; the other at Cape Town, South Africa. Also, imagine the tassel of the shade cord to be replaced by the moon, and the view out your window replaced by the fixed star groups.

Let us suppose that when the giant closes his Cape Town eye he sees the moon at the south of the group of stars called the Pleiades. When his Berlin eye is closed the moon will apparently jump to the north of this star group.

The angular distance between the two places where the moon seems to be when viewed simultaneously by observatories at Berlin and Cape Town is used as one angle of a triangle. Two sides of the triangle are the lines of sight from the observatories to the moon. The third side is the line that joins the two observatories, running straight through the curving earth.

This short side of the triangle is of course known accurately, and the three angles of the triangle are also known. By using a simple rule of trigonometry, astronomers then find it easy to calculate the two missing sides of the triangle, which of course gives the moon's distance from the two observatories.

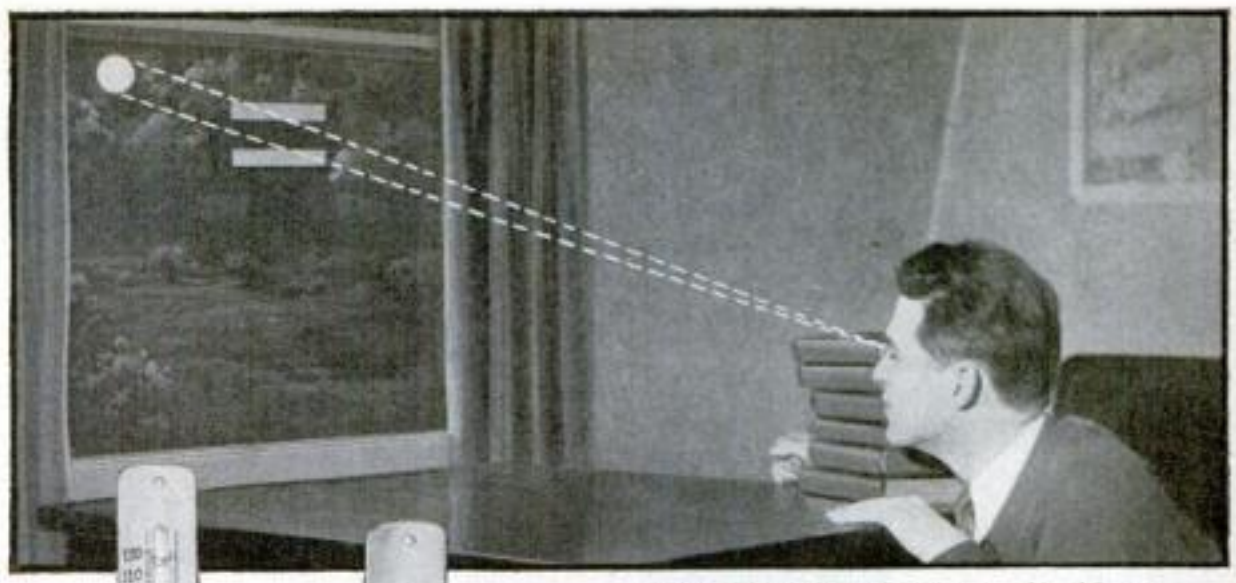
We have not merely imagined this case of the two observatories, for the British Government established the Royal Observatory at Cape Town primarily for the purpose of finding the moon's distance in collaboration with the Berlin observatory.

Observations of parallax made from two points, or eyes, in different parts of the earth, do very well for measuring the distance of a comparatively near object like the moon, but they would not do in calculating the distance of the nearest fixed star! For this purpose the two eyes must be placed just as far apart as possible.

How far apart can our two standpoints be placed? The longest possible distance that we can put between two observations of a star's position is, obviously, the entire width of our earth's orbit around the sun. Several months must of course elapse between them. This distance, about 186,000,000 miles, is accordingly used by astronomers as the short side of the triangle when measuring the parallax of fixed stars.

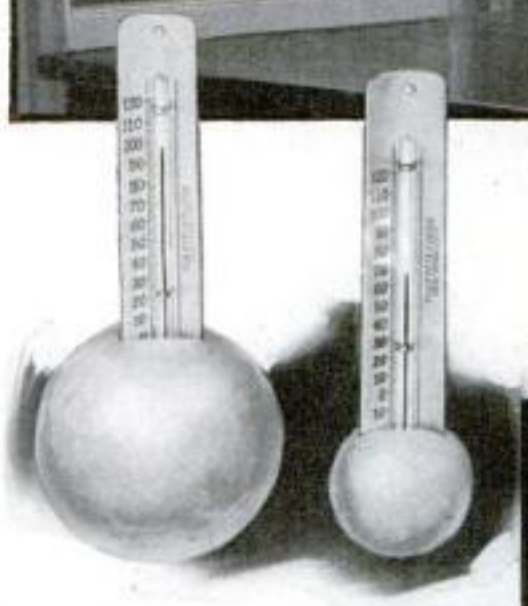
It would seem that every star in the universe must show a large shift of position when the eyes viewing it alternately were 186,000,000 miles apart, but some stars are so infinitely remote that they show no shift that can be measured. Even Alpha Centauri, the nearest fixed star, shifts less than one thirty-six hundredth of a degree, while the earth moves from one side of its orbit to the other. If you could see a mere pin point of light eleven miles away, and viewed it alternately with right and left eyes, the difference in its apparent direction would be just the parallax of Alpha Centauri. This gives an idea of the accuracy needed to measure the distance of even the nearest fixed star.

An experiment you will have fun trying enables you actually to measure the moon's diameter. The only apparatus needed is a *(Continued on page 97)*

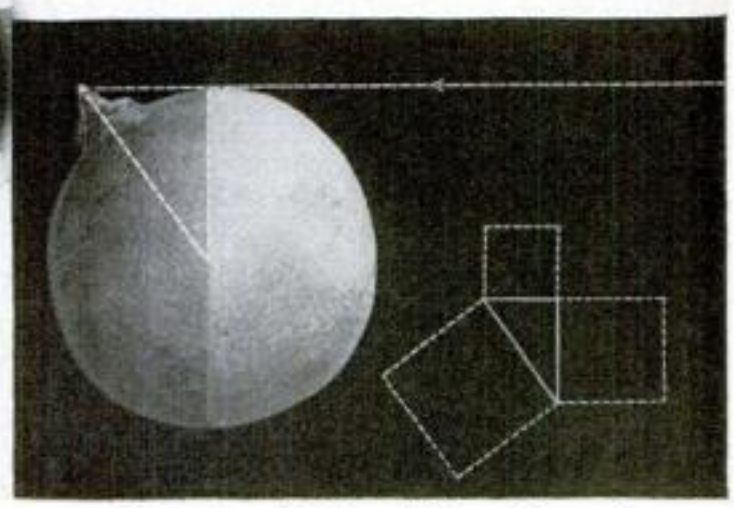


How You Can Measure the Moon

Paste two strips of adhesive tape on a window that gives a clear view of a full moon. Then sight at the moon over the corner of a pile of books placed on a movable table. Move the table back until the moon's image just fills the space between the tapes. Next measure the distance of your eye from the tapes and the space between the tapes. A simple problem in proportion enables you to compute the size of the moon

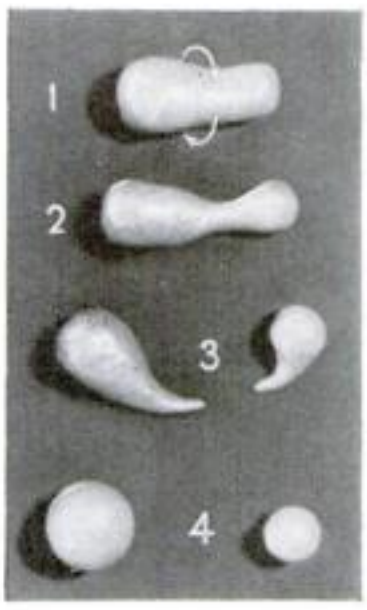


Two balls of plastilene, of the relative sizes shown above, and each containing a thermometer, are heated to the same temperature and then allowed to cool. As the smaller ball has a much larger surface in proportion to its weight than big ball, it cools faster. This explains why the moon is cold and the earth warm



Measuring Height of Moon Mountains

To find the height of moon mountains, an astronomer measures the distance from the line between the light and dark parts of the moon to a mountain top just touched by the sun's rays. This distance, along with the known radius of the moon, gives him the two sides of a right-angled triangle. Then it is easy to compute the third side from which he subtracts the moon's radius and this of course will give him the height of mountain



Models at left show how the moon may have been torn away from the earth. As No. 1 revolves it gradually takes the form of No. 2. Later the ends separate as in No. 3. Further revolution remolds each into a sphere, as in No. 4. The Pacific Ocean may fill the hole left when the moon flew off

This diagram, drawn accurately to scale, shows you the real orbit of the moon around the earth, which, as you see, is slightly wabbly and always concave to the sun

New Methods for
Care of Dogs
Upset Old Ideas

STRIP, DON'T CLIP, YOUR DOG

In the picture above, Scottie is being stripped. In this process, the old hairs are pulled out without causing any pain. Clipping a dog is quicker but it leaves him without necessary protection

Close-up, above, shows how to trim the dog's toenails. If the nails are permitted to grow long, you will pay the penalty in torn rugs and in ripped silk stockings

A safe and painless muzzle for your dog is shown at the right. It is made of four-inch surgeon's gauze as described in the text. It will not bind but will keep the mouth closed and is better than a leather muzzle which is too hard and too heavy

SEVEN pointer puppies dashed from their kennel at the crack of a rifle shot. They rubbed their tiny noses against their master, unafraid, ready for the big adventure.

Several weeks later as they raced through the nearby woods, rifle shots and the boom of a shotgun echoed through the trees. Each puppy received the signal calmly, halted instantly, and stood pointing toward the direction his master was facing.

They had reached the high-school stage of their training, which had started in early puppyhood when their owner signaled mealtime with the crack of a whip. Light and finally loud shooting followed in due course as the dogs became accustomed to these unusual sounds. Whip and rifle meant to them something interesting, not something to fear, and all this preparation was to keep them from ever becoming gunshy.

Many unlovely traits develop in dogs simply because of the master's carelessness. Gunshyness is a case in point. In most cases even this can be cured if the owner is sympathetic and starts early enough.

There is no reason why bad habits should develop in certain breeds, such as gunshyness and hard mouth in bird dogs. These traits depend entirely upon environment and the owner. Other ideas are equally wrong. Collars cause goiters, you are told; raw meat makes a dog vicious; the mouth of the pure-bred dog always has a black roof; you cannot wash a puppy in safety during the first six months; a misalliance in the pasture ruins a female for all time. Silly ideas!

A few simple precautions will enable you to raise healthy and happy dogs and enjoy them to their ripe old age. Also they will make it possible for you to develop in them habits of cleanliness and deportment that will be a pleasure to you and your family. Since some 12,000,000 dogs are enjoying life in the United States today, these rules should find wide-spread application.

Mentally every dog is very much what you make him. If brought up from puppyhood in an unchanging household, he gets to understand the family's ways and wishes and in time will adapt himself to his master's personality, devoting himself to his master alone. On the other hand, the mature dog that has known several masters has acquired some of the individuality of each to the confusion of his own.

The earlier you and your dog come to an understanding, the better for both. It is well if, in the beginning, he come to you with no objectionable habits or vices to be unlearned. It is much easier to school him to a new habit than to cure him of an old one.

One of the greatest joys an animal lover can know is the manifestation of loyalty exhibited by a dog he has reared from babyhood. Don't kill your dog with kindness but teach him you are to be trusted.

Before the litter arrives, feed the expectant mother normally, say, one good meal in the evening consisting of raw round steak or hamburger mixed in equal parts with bran or other roughage. If she has some favorite food, give her that. A small meal will meet the morning's requirements.

If you want your dog to look well groom him frequently. The long haired terrier, below, is having the snarls combed out of his coat but the dachshund is made glossy with the soft side of a fiber hound glove

By

H. M. ROBERTSON

•

The three-sided bed, below, with a mattress filled with cedar shavings, is ideal for the puppies as it gives them protection from drafts and at the same time affords much liberty

She probably will refuse food during the last day and will make her own bed. Do not offer help in this, but provide her with the necessary materials and let her go ahead with her own plans. Get a box or a large cardboard carton and cut a liberal opening in one side three inches from the bottom. This will be low enough to permit her to go and come, yet will be high enough to prevent the puppies from straying away.

Place several sheets of newspaper in the box. She will tear these up to suit herself. Do not, under any circumstances, place blankets or old clothing at her disposal, as the young may crawl underneath the folds or into an arm or pocket and suffocate. After birth, remove the torn papers and place new ones in the box. They will not be torn again.

If you have a yard where the prospective mother will play, do not permit her to dig a hole under the house or garage. Despite any other preparations, she would be sure to have her litter there.

Nothing more will be required during the first four or five weeks, except in the case of terrier or spaniel puppies. Custom decrees that these, and a few other breeds, shall have abbreviated tails. When they are three or four days old you may cut their tails. Use sharp, sterilized scissors, paying no attention to joints or the so-called necessity of tying to prevent bleeding. Contrary to general belief, this is a painless operation and little or no blood will flow. Cut, and do nothing more.

The mother will wean her brood when they are about five weeks old. Then you should give them a diet of raw, scraped beef mixed with bran. A week later some mild vermifuge will be helpful. For this purpose, a little garlic or sage in the food proves effective.

If one of several puppies suffers malnutrition, take him away from the others. He usually will need vitamines, the absence of which in his feed has been weakening his bone structure. It may be that calcium phosphate will fill the void. In addition to his meat diet, feed him plenty of raw eggs, together with cod-liver oil. Prepared charcoal in the morning will aid the digestion. Some authorities say a little sugar added to the food will help conquer, or prevent, rickets.

Dogs of all ages need exercise and plenty of food and water. Food should consist of one-half roughage and one-half raw meat. Always remember that the dog is a carniverous animal and must have meat. He will digest fish, eggs, and meat in their entirety. The roughage may consist of vegetables, bran, toast, or some of the prepared wheat products.

These, of course, provide for his physical life. There is another side which I shall call the psychological, for dogs, like humans, require a certain amount of freedom. Even granting that puppies are born unequal physically and mentally, their environment and the care and kindness with which you rear them determine their disposition at maturity. Don't keep them cooped up in a kennel or in the house. Permit them to see people early, take them out on the street or for drives in the family automobile. As a rule, only those kept eternally chained have vile dispositions.

Deprive an animal wholly of his liberty and he may develop fears and phobias that will bring heartaches to you later. He learns early to associate ideas. This is especially true of sounds. Pointers and setters particularly should be broken to their allotted missions while young. No dog should be permitted to run wild during the first twelve months, if you expect him to be endowed with perfect manners and a tender mouth. In fact, training for the field should begin at seven months of age.

This concrete dog house, which has a removable wooden floor, will keep your dog cool in summer and warm in winter and also it is sanitary

No bad habit can be cured by adding to the animal's woe. It merely becomes terror stricken, ruined for all future good. I might add that whipping is a mistake unless you catch the animal directly in the wrongful act and apply the punishment immediately. If you defer the punishment, he will be confused as to its meaning and probably become afraid to perform any natural acts in your presence.

Many playful antics, cute in a puppy, become bad habits in maturity. If you permit a pup to bark *(Continued on page 102)*

New Federal Service to End

It has long been known that terracing is an effective way to prevent soil erosion and at left, a Government expert is describing the process to a group of farmers

Soil is prevented from washing down this steep slope by the long lines of terraces. This system of controlling erosion is advocated under certain conditions of soil and rain-washed slope

By JOHN E. LODGE

FIVE million dollars has just been set aside by the U. S. Government to be used in fighting soil erosion.

Under the Public Works Administration, the Department of Interior has organized a new bureau, called the Soil Erosion Service. At its head is H. H. Bennett, one of the world's leading authorities on agricultural erosion. Throughout the nation, it will demonstrate methods of stopping soil washing which, it is estimated, costs American farmers $500,000,000 a year.

Experts of the new service, working in many farming districts, will teach all of the old and new soil-saving methods that prove to be of value when tested under local conditions. But experience gained during his twenty-five years of work as a soil expert in the service of the Department of Agriculture has convinced Bennett that strip cropping, an agricultural method that has been used by the prosperous Pennsylvania Dutch farmers for many generations, is the most generally useful of anti-erosion methods.

The soil of the Missouri valley is the best corn-growing soil in the world. But each year much of it is washed away. Some of it silts up streams and makes their navigation slow and expensive. The rest is dissolved, flows with the flood waters into the Mississippi, and eventually is carried out to sea. All of it is lost for corn growing.

Soil experts tried an experiment in this region. They picked out two farmers who planted their corn on slopes that averaged eight per cent. Of one farmer they asked nothing but permission to install a measuring device. They asked the other farmer to plant his fields in alternating strips of corn and alfalfa.

At the end of a year the soil experts' measuring devices told them that the farmer who had used the usual method of planting his corn had lost nine tons of soil an acre from his fields.

The farmer, who had adopted strip cropping, had lost only one pound of soil an acre!

Three-quarters of our farm land is so sloping that its topsoil may be washed away by rains heavy enough to cause water to flow freely over the fields.

It is estimated that there are in the United States about 500,000,000 acres of land suitable for cultivation. Already our farmers have permitted the destruction of 35,000,000 acres of good crop land. In the last fifty years more than 100,000,000 of the 350,000,000 acres of land now in cultivation have lost all or most of their topsoil. At least 160,000,000 additional acres have been damaged more or less seriously by erosion. Last year 3,000,000,000 tons of soil were washed out of fields and pastures. Under normal price conditions, this would have caused a loss of $500,000,000 to the farmers who own the land.

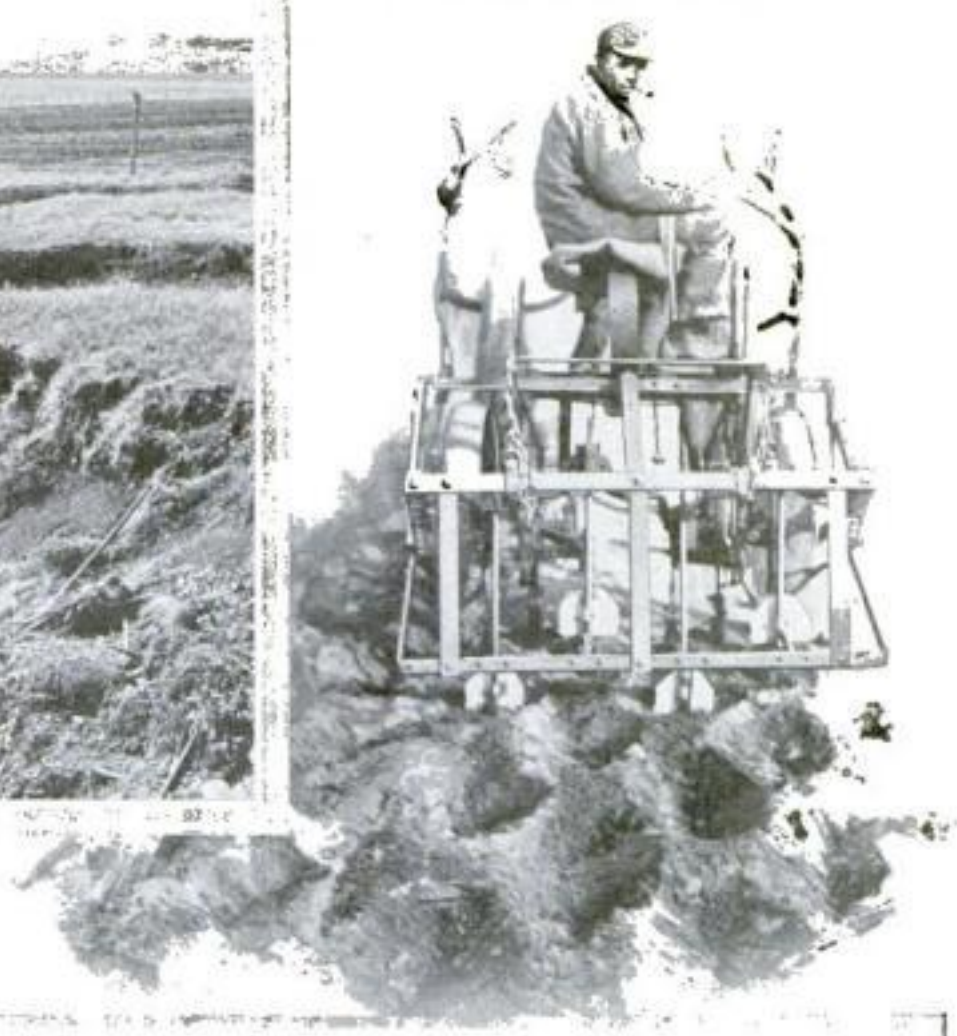
Standing on the brink of a 200-foot gully near the town of Lumpkin, in Stewart County, southwestern Georgia, I got a vivid idea of what soil erosion can do and mean.

At first view, this sand-sided gash seemed just another freak of nature. But actually it is the result of a farmer's ignorance of effective means of combating soil erosion.

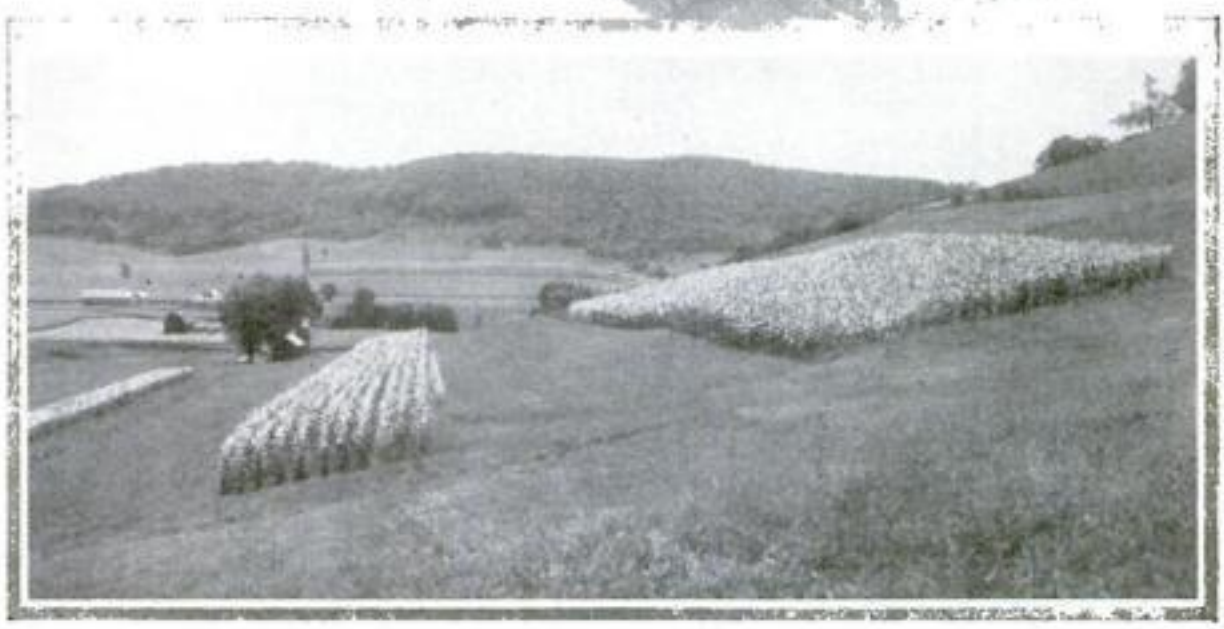
Fifty years ago, old-timers told me, that gully was not there. The fertile fields of

Destruction of Our Farms

This soil-saving Davis cultivator, used to turn the earth in shallow holes and so prevent the washing away of the fertile top layers, help save our farms



Above, an erosion gully in Texas that destroyed a large amount of valuable land. A government expert and farmers are inspecting it. Below, strip-cropping a Wisconsin farm



a prosperous farmer stretched where it now cuts deep into the earth. In one of those fields, over what now is the center of the gully, stood a barn.

Naturally, when it rained hard, water ran off the roof of this barn. Then, of course, it ran down hill across the sloping fields. As it went, it took some of the topsoil with it, and soon cut a modest channel for itself.

Knowing that it is the nature of water to run down hill, the farmer took no measures to stop it. In a year the little channel became a deep ditch. In another year the ditch grew to a shallow gully. Each heavy rain made it deeper and wider. Little side gullies began to feed it water and soil in rainy weather. In a few years the gully cut through the topsoil and into the underlying sand.

Each year now it grew much deeper and much wider. One wet day, the barn crashed into it. Still the gully grew. A tenant house followed the barn. A schoolhouse followed the tenant house. Finally, the family graveyard was engulfed. By that time all of the topsoil of the fields had been washed into the hungry gully. The farm had become a barren waste, and the once-prosperous farmer had been forced to make a new start elsewhere.

Many other gullies, with similar histories, have been at their work in the same district. In less than half a century, 70,000 acres of the best farming land in Stewart County have been destroyed.

In Muskingum County, Ohio, there is another tragic example of what soil erosion can do—the eighty-acre Redding Farm, once the most fertile in the county. Its owner found corn growing profitable, so he grew corn. Gullies began to cut into his fields, but he went on growing corn. Now there is exactly one acre of the farm on which it is possible to grow anything. The other seventy-nine acres are an erosion-furrowed waste.

Strip cropping would have saved the farms of Stewart County, Georgia. It would have saved the Redding Farm, and several thousands like it. It would have saved the 90,000 acres of good land that have been destroyed by gullying in a single South Carolina county.

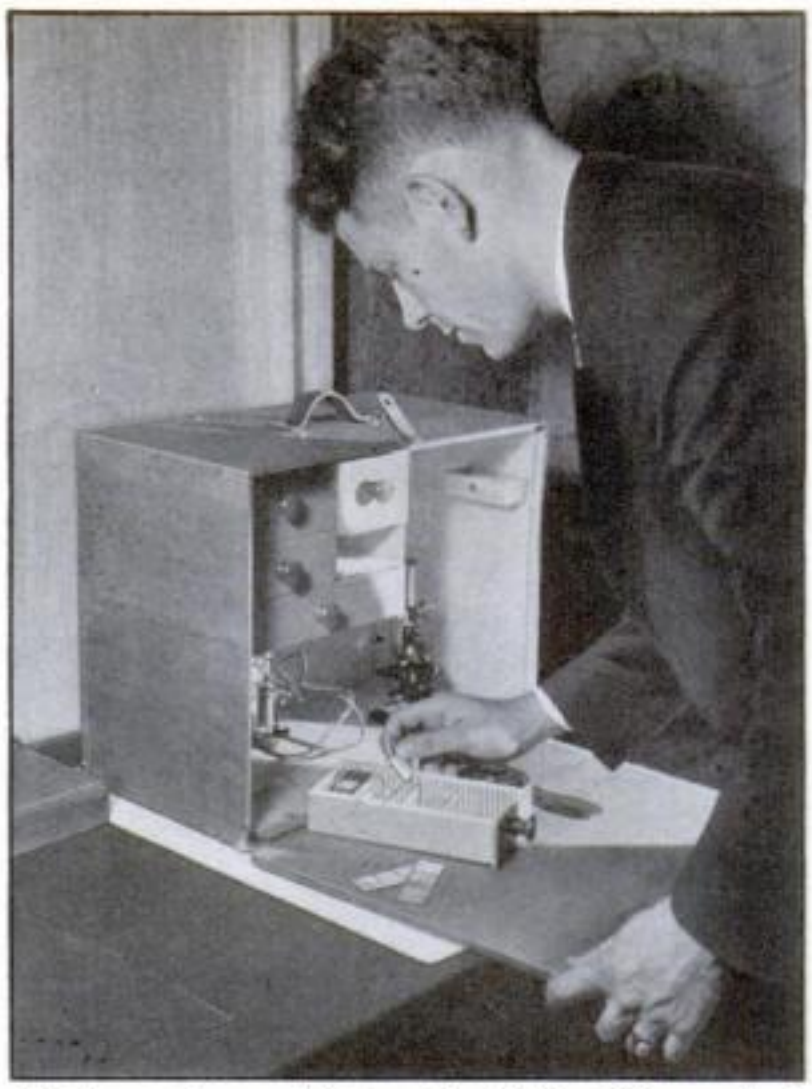
Farm land from which all the topsoil has been washed away is hopelessly lost for profitable crop growing. Of course, even subsoil, if you will work over it hard enough, will grow something. In fact, tens of thousands of our farmers are subsoil farmers. But it is a losing game—bankrupt farming on bankrupt land.

The work of Soil Erosion Service is not the rehabilitation of fields that have been ruined by soil washing. The efforts of the new service will be concentrated on teaching farmers how to guard the rich lands that so far have escaped, and how to stop soil erosion of fields that now are losing their topsoil.

To do this, large-scale experiments and demonstrations will be made, with the cooperation of local land owners, in ten major agricultural districts.

The soil-conservation methods used and taught will vary with the conditions of soil, average slope, and climate. In the fertile hills of Wisconsin, strip cropping will be used on *(Continued on page 98)*

A Portable Kit for your MICROSCOPE



The kit contains a special drawer in which the slides are placed

By Morton C. Walling

A PORTABLE kit that holds your microscope, various bottles, instruments, illuminator, microtome, specimen boxes, and slides will enable you to take your hobby with you wherever you go. You can use the kit on your desk, workbench, or the kitchen table; and it affords a convenient place to store your equipment when not in use.

Being designed to hold a full-sized microscope and accessories, the kit is somewhat larger than would be necessary if the small microscope seen in the photographs were to be used with it exclusively. Also, the size was determined somewhat by the dimensions of the laboratory table to which it is an accessory.

There is nothing difficult about making the outer case because in reality it is a plain box with a removable door in front. It can be made of whatever wood is available. If the parts are carefully squared, the joints well fitted, and glue is used as well as nails and screws, the case will be both strong and neat. When a small circular saw is available, however, the case can be made with rabbeted joints as shown in the accompanying illustrations. In the original model, five-ply-maple veneer paneling ⅜-in. thick was selected for the outer case, and ⅛-in. thick three-ply veneer for the drawer case. White pine ¼-in. thick was used for all parts of the drawers except the sidepieces of the slide-filing drawer, which are ½-in. thick. If solid wood is used for the outer case, it should be ½-in. thick.

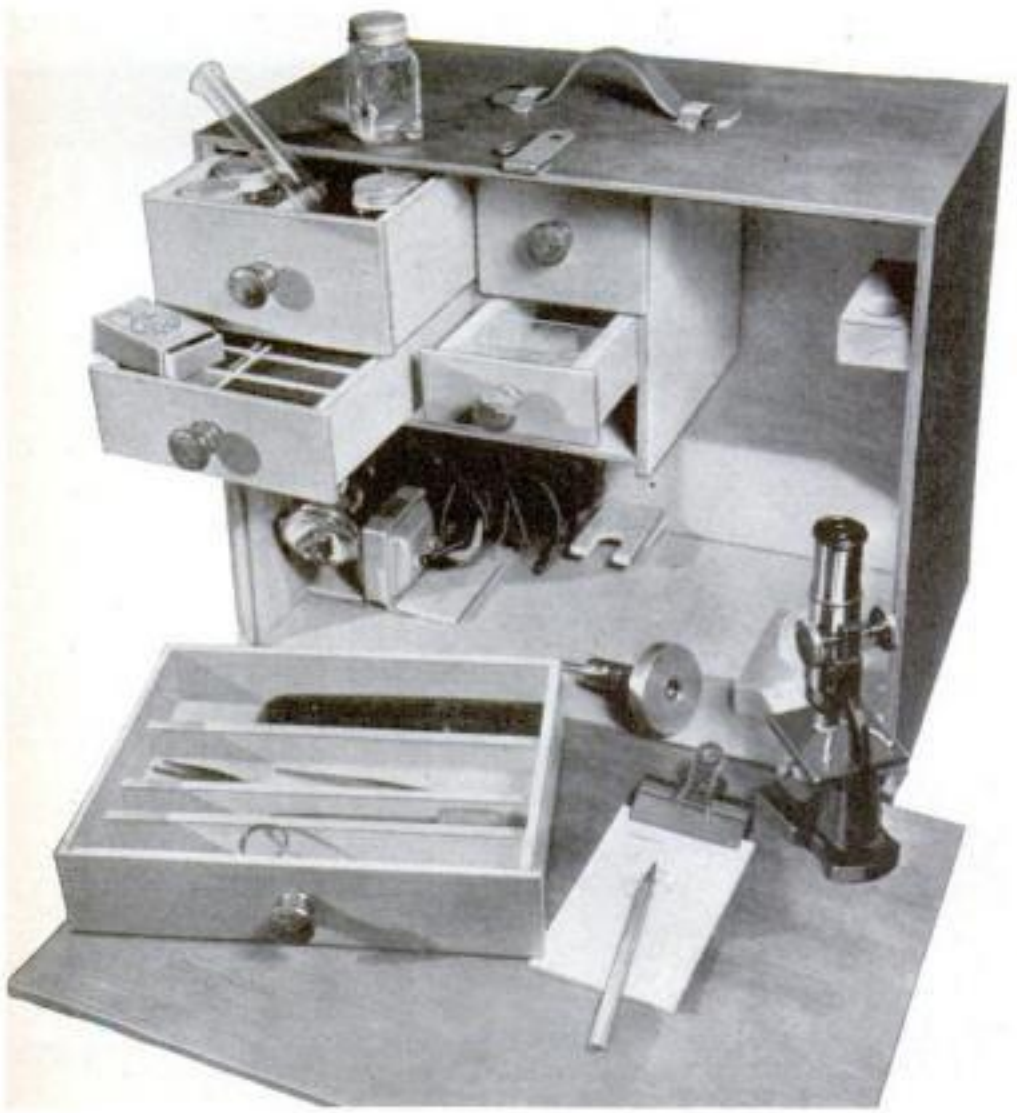
The case is 17½-in. long, 14-in. high, and 9½-in. deep, outside dimensions. If ⅜-in. thick veneer paneling is used, make the end piece 9½-in. by 14-in. and cut rabbets 3/16-in. deep by ⅜-in. wide around all four edges of each on the inside surfaces. The top and bottom will be 9½-in. by 17½-in., and should be rabbeted along both of the longer edges, on the inside surfaces. The back and front are 13⅝-in. by 17⅛-in. so as to fit in the rabbets. The edges of the front board should be dressed so that it will slip in easily but snugly; the back, however, should fit reasonably tight. Fasten the ends, top, bottom, and back together with glue and brads or slender round-headed screws.

Four brass box corners are mounted on the lower four corners of the case. Those in front form pockets into which the two lower corners of the front board can be slipped. The upper edge is held by a hasp and staple with either a hook or a padlock, as preferred.

The inner case for the drawers can be made as a separate unit—that is, like a box with top, bottom, two ends, and the necessary partitions, and inserted after it has been assembled. The author, however, built the drawer case right into the larger case, as shown.

The drawers are made to fit the openings in the drawer case. The fronts, however, are a little larger than those openings because they overhang the edges of the drawer case. None of the drawer fronts, however, projects at the top in the plan given.

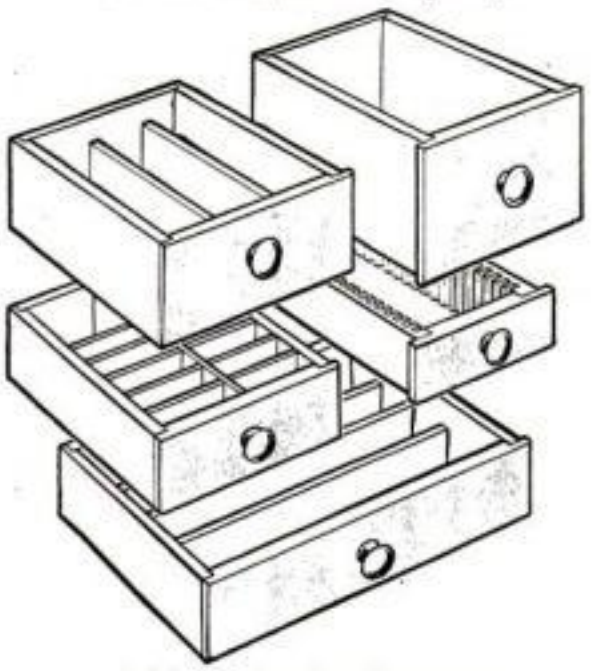
Some of the drawers have inside partitions. The upper left-hand drawer for test tubes has three strips running from front to back. The specimen boxes used in another drawer are empty safety-match boxes. At the rear are two compartments for miscellaneous objects. The lower drawer for instruments has three partitions, variously spaced, running across from side to side. In constructing the slide drawer, the slots in the sidepieces can be made easily on a circular saw or in a miter box having some kind of spacing arrangement. The grooves are spaced on



Here is the portable microscope kit, completed and ready for use. Note the surprising amount of equipment that can be carried in it. There are clips to hold the illuminator, microtome, and microscope and a spring clamp on frontpiece for a note pad

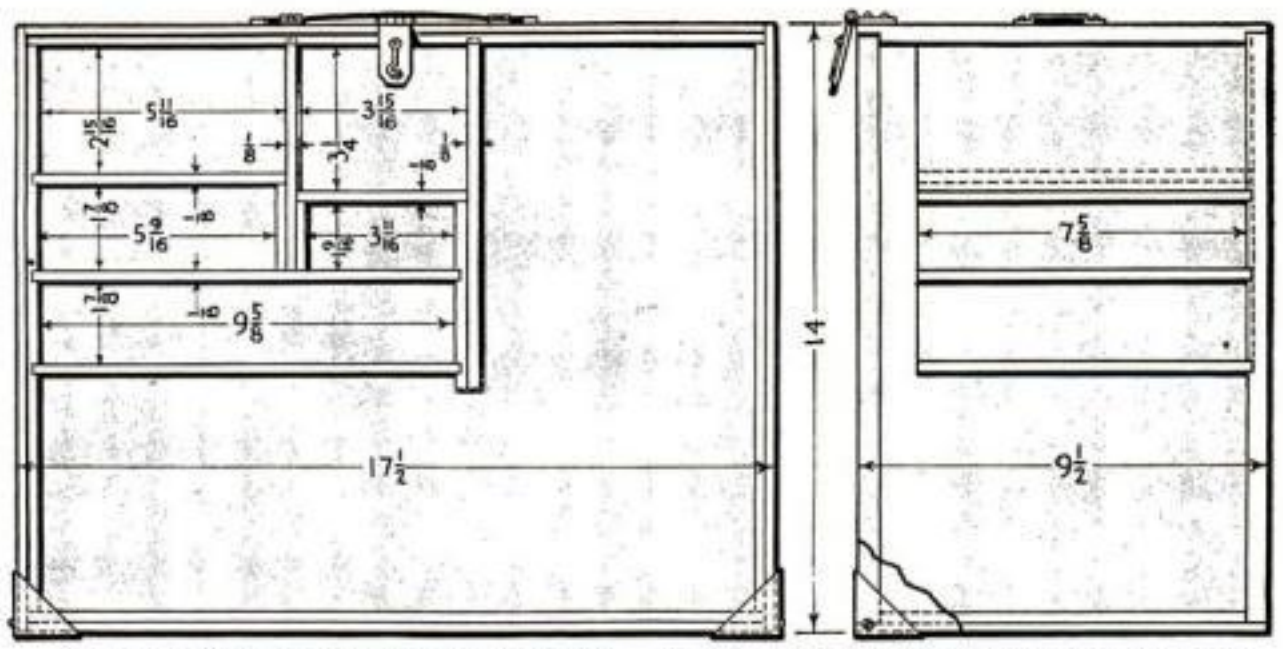
Blueprint Now Ready

To assist you in building the portable kit for your microscope described in the accompanying article, POPULAR SCIENCE MONTHLY *has prepared Blueprint No. 220 which will be sent to your address on receipt of 25 cents.* *See the coupon on page 84.*



A Treat for the Amateurs

EVERY amateur microscopist will be interested in the article on page 11. And next month there will be another article in the fascinating series on the use of the microscope



Above, working diagram of microscope kit. At left, its drawers with partitions in place

3/16-in. centers. The upper right-hand drawer is for miscellaneous supplies and has no partitions. If desired, two additional slide drawers can be substituted for it. In the portion of the case not occupied by the drawers are various clamps and other fittings. The eyepiece holder, fastened to the side of the box near the microscope, consists of a strip of wood having a row of holes. It is best to construct this holder so that the holes have closed bottoms, and to line them with some soft material such as felt. The exact design of all clamps will depend on the equipment itself.

The illuminator illustrated consists of a bell-ringing transformer equipped with a flashlight reflector and a No. 40 6-volt radio dial light. If you are traveling where there is no 110-volt electric supply, you can substitute a dry-cell battery for the transformer, and use a low-voltage focusing-type flash-light bulb instead of the No. 40.

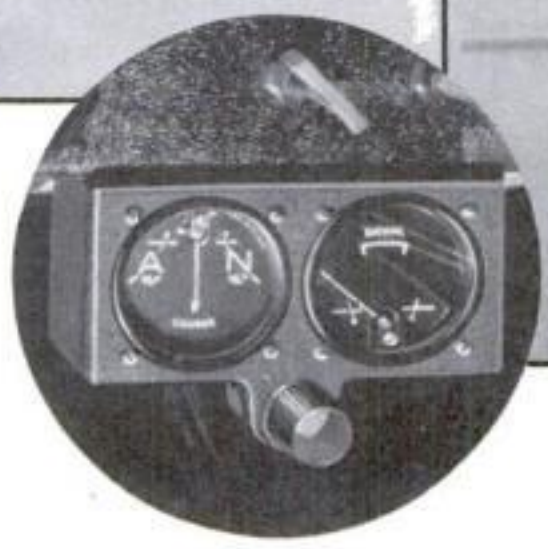
You will find that a spring clamp, similar to those employed on clip boards, mounted on the inside of the front piece near the top and directly in front of the drawers, will be handy for holding notes. The front board thus becomes a convenient drawing board.

The outside of the kit can be finished in any conventional manner, and the inside surfaces left in their natural state. A set of furniture slides on the bottom of the kit box is an improvement.

The cost of the kit illustrated, including bottles, specimen boxes, and clamp, was about four dollars, more than half of which was for the maple veneer paneling. This means that the kit can be built for as much or as little as you wish.

DANGER IN BLIND FLYING REDUCED BY INSTRUMENTS

Left, movable loop of plane's direction finder mounted on top of wing. By means of the handle in the cockpit, right, it is trained on a broadcast station and the dial then shows the pilot if he is on his course



At left is the new visual indicator that interprets the dots and dashes of the radio beacons on established airways. It takes the place of the signals heard in headphones

FLYING in fog is made safer by a new radio direction finder for planes not traveling on established airways, and by an improved visual indicator for receiving radio beacon signals on regular lanes. When the direction finder, a revolving loop mounted on the wing, has been trained on a broadcasting station, a dial, connected to the plane's radio set, shows constantly whether the pilot is on course. The other instrument interprets the dots and dashes of the range beacons, its needle swinging toward an "A" or "N" when the pilot is off his course.

Suction Dredge Mines Gold Beneath Water

A GOLD dredge that will bore its own way to deposits of the precious metal buried underwater, and then bring the pay dirt to the surface by suction, is the aim of Bert O. Godfrey, Brooklyn, N. Y., inventor, (P. S.M., Dec. '31, p. 37). He has just designed such an apparatus to work on the principle of a dressing-table atomizer. Its business end is a suction nozzle at the bottom of a double-walled pipe, which is lowered from a barge or truck. To bring up gold, water is pumped down to the nozzle through the outer section of pipe. Curving walls discharge the jet back upward through the central pipe with such force that it travels all the way to the top. Moreover, so powerful a suction is created at an orifice in the bottom of the nozzle that gold-bearing sand and even solid nuggets, Godfrey says, will be carried along with the stream so that they can be recovered. If the suction orifice becomes clogged by a rock or other foreign object, it is merely necessary to shut off a discharge valve at the upper end. This reverses the flow of water which, issuing from the nozzle, blows it clear, and the discharge valve may then be closed to resume recovery of gold. The same procedure is followed to dig a hole with the device, since the hydraulic jet rapidly eats its way into a soft bottom. Quantities of lead shot were raised from the bottom of the harbor of Seattle, Wash., in tests of his device, the inventor reports; and he declares that he also has successfully raised gold nuggets, of which he bought $200 worth especially for the test, with a twenty-foot laboratory model of his suction pipe. These successes suggest that the device will prove of considerable practical value.

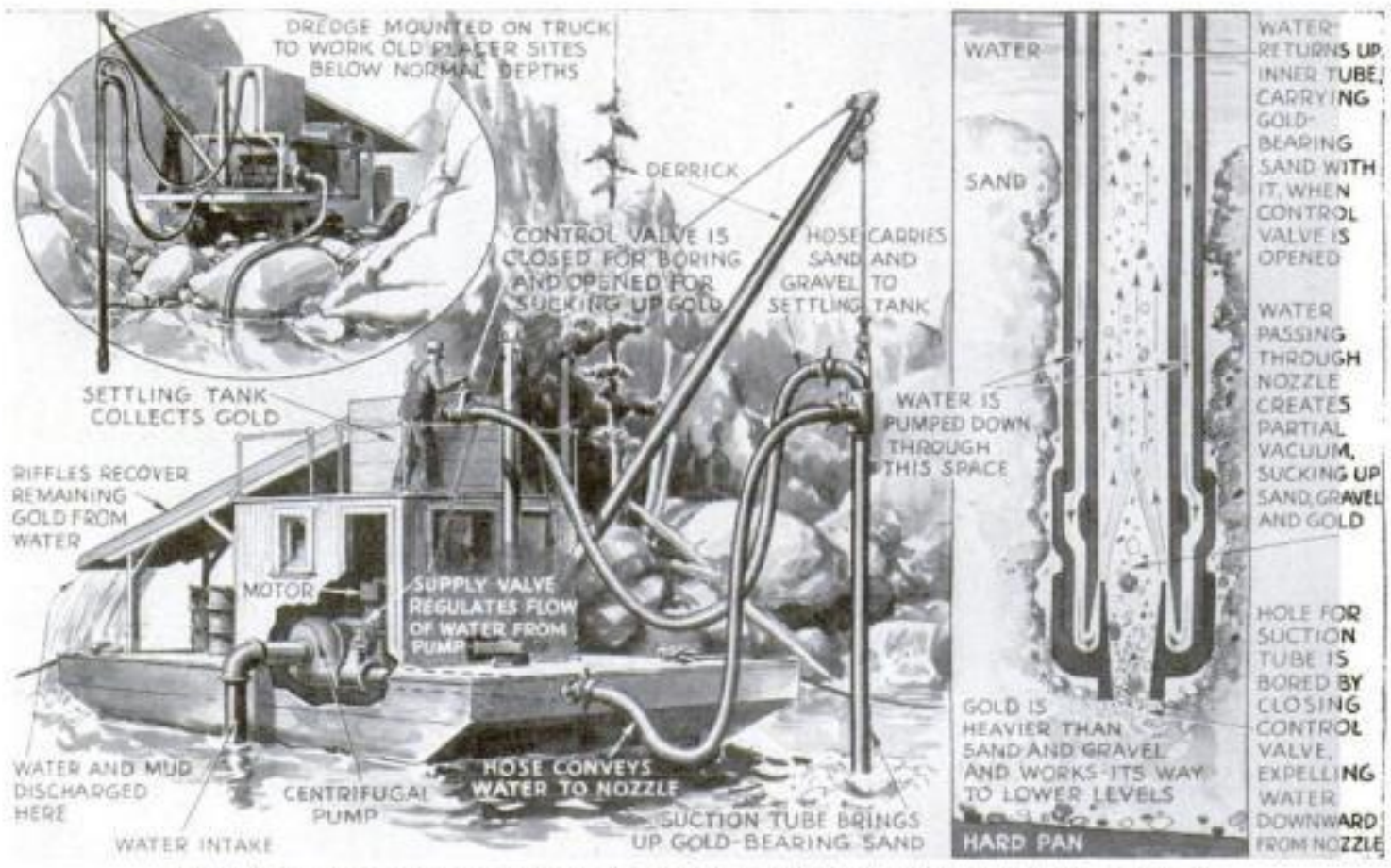
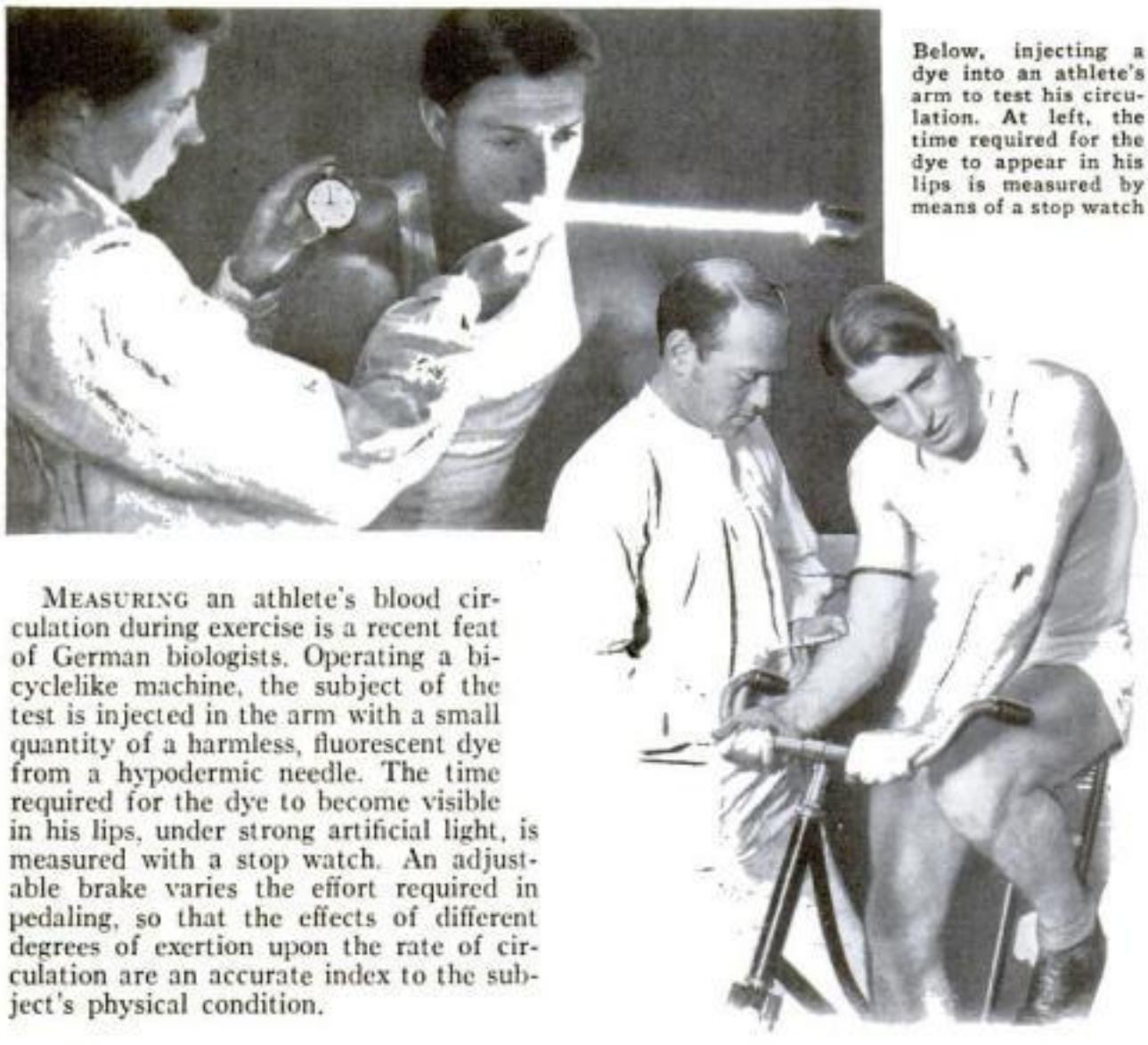


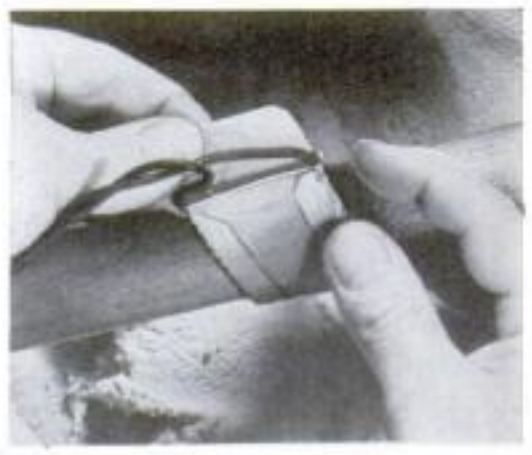
Illustration above shows the manner in which the new gold dredge will lift the precious metal from a mine beneath the water by means of pressure created in the double-walled pipe

DYE TESTS ATHLETE'S CONDITION



Below, injecting a dye into an athlete's arm to test his circulation. At left, the time required for the dye to appear in his lips is measured by means of a stop watch

MEASURING an athlete's blood circulation during exercise is a recent feat of German biologists. Operating a bicyclelike machine, the subject of the test is injected in the arm with a small quantity of a harmless, fluorescent dye from a hypodermic needle. The time required for the dye to become visible in his lips, under strong artificial light, is measured with a stop watch. An adjustable brake varies the effort required in pedaling, so that the effects of different degrees of exertion upon the rate of circulation are an accurate index to the subject's physical condition.



An electric heating element, in a collar of copper, is attached to thaw out a pipe

ELECTRIC HEATER THAWS OUT PIPES

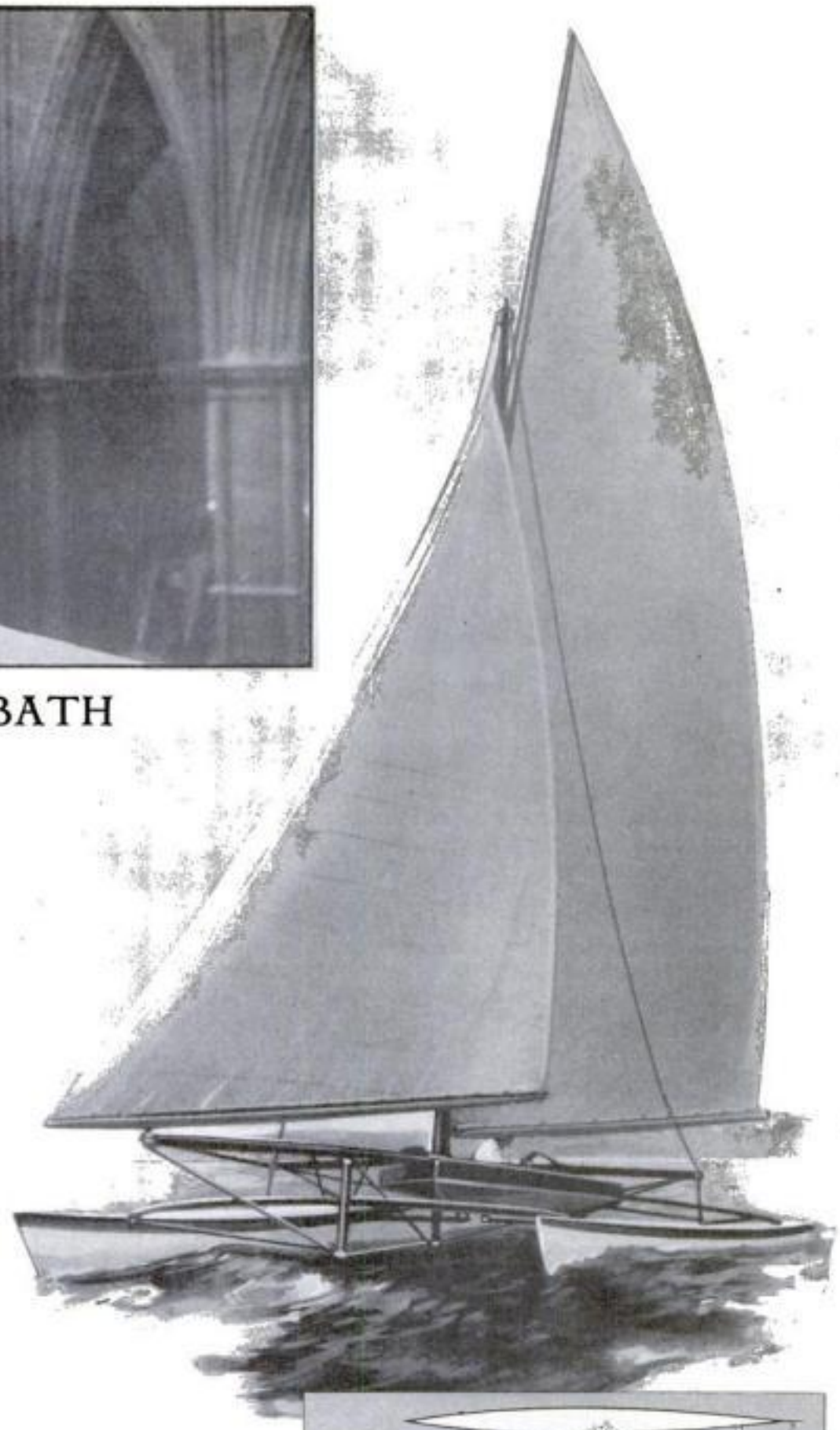
SUITABLE for thawing a frozen water pipe or for keeping the radiator of a car from freezing in a cold garage, a new electric pipe heater consists of a heating element embedded in a flexible collar of thin copper. It is readily drawn tight on a pipe and fastened as shown above, without the use of tools, while the attached electric cord may be plugged into any outlet. The device immersed in a glass of cold water will, its manufacturer says, quickly bring it to the boiling point.

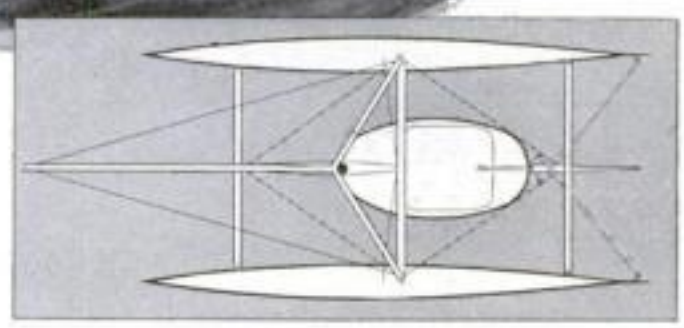
FAMOUS ABBEY GETS MILK BATH

HISTORIC Westminster Abbey, famed British sanctuary, in which many of England's great men famed in literature, art, and statesmanship, are buried, recently received a milk bath. Busy workmen applied gallon after gallon of skimmed milk to its massive arches, pillars, and even its statues. The unique treatment, recommended by architectural experts, was intended not only to clean the stonework but to aid in preserving it. The results will be watched with care, although it is said five years must elapse before the value of the treatment is apparent.

BLOWTORCH FIGHTS FOREST FIRE

BY THE odd expedient of fighting fire with blowtorches, forest rangers are limiting the ravages in timber lands. The portable outfit, shown in action below, has been tried out successfully at Carson, Wash., as a means of starting a backfire. Gasoline carried in a tank on the forester's back feeds the hand torch, which speedily ignites stumps and brush, while cleared areas check the resulting blaze. With the trees in its path destroyed, the fire is quickly controlled.





Above, the two-hulled racing catamaran as it appears in action. Right, plan of the hulls and cockpit

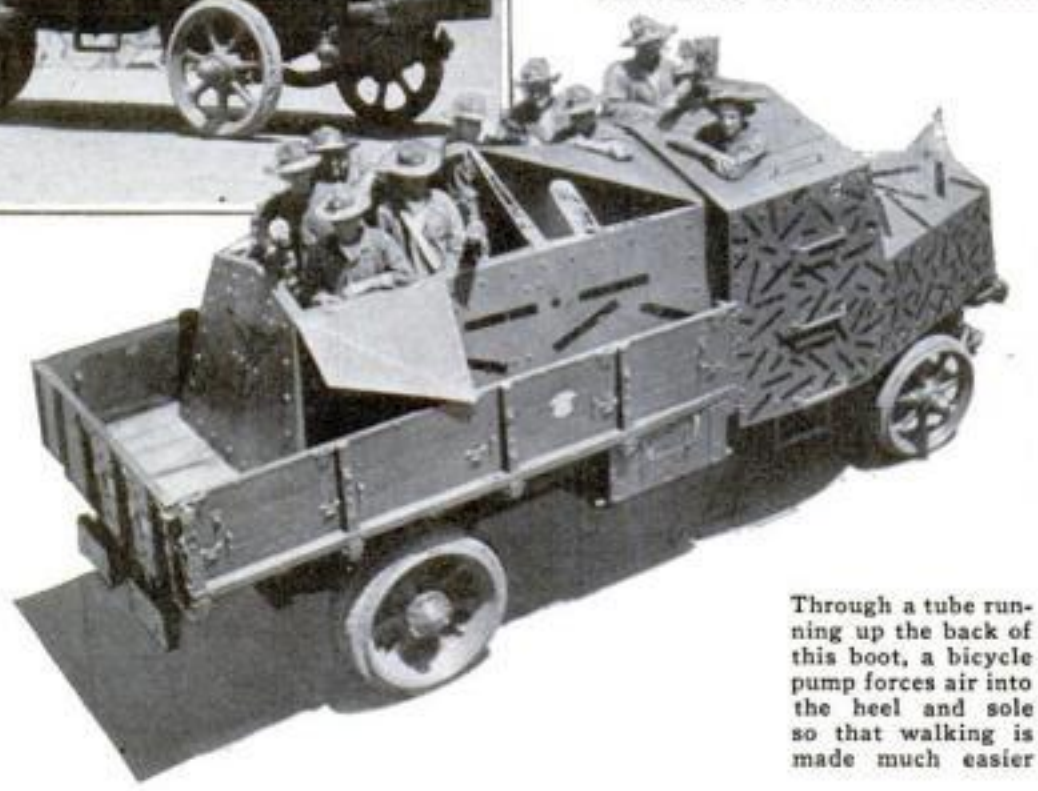
TWO HULLS ON NEW RACING SAILBOAT

NEW styles in sailing craft are set by the racing catamaran *Amaryllis*, latest creation of Nat Herreshoff, whose yachts have often victoriously defended the America's Cup. The veteran boat builder declares his new design offers extraordinary speed in a sailboat, while it makes an upset almost impossible. Its type is virtually without precedent, mainly because its fundamental principles have not hitherto been fully understood. The boat has two pontoon-like hulls of thirty-three-foot length, joined by cross members that terminate in ball-and-socket joints, giving the hulls some latitude of movement with respect to each other. A cockpit like that of an iceboat, supported between the hulls, accommodates a crew of six. Each hull has a centerboard and rudder, and the two rudders are rigged to swing simultaneously with a single tiller. The sail area totals 900 square feet. Should boats of the new type prove popular, the builder foresees races that will provide new thrills.

EMERGENCY WAR TANKS MADE OF STANDARD ARMY TRUCKS

BY CONVERTING ordinary military trucks into war tanks, to aid in scattering anti-foreign mobs, U. S. Army regulars stationed at Tientsin, China, have added to the safety of Americans in that country. With no tanks or armored cars immediately available in China, the men obtained two standard trucks and armored them with five-sixteenths-inch steel. Combat turrets, fitted with three machine guns apiece, were added, and a fourth machine gun was mounted in each cab. Loopholes for the guns are concealed by a camouflage of imitation loopholes.

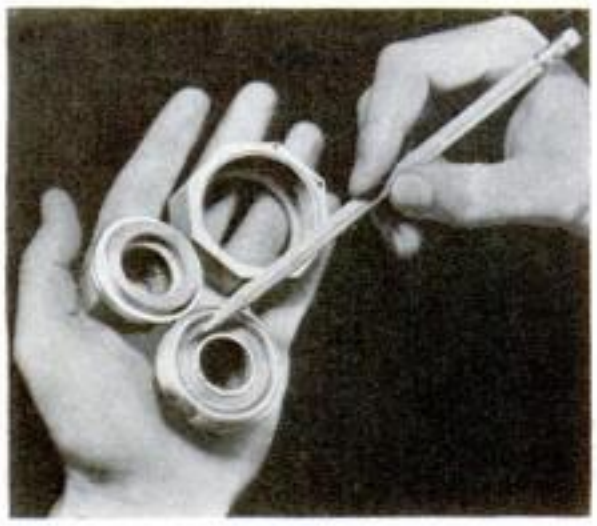
Above, Army truck converted into war tank by having armor placed on sides and top. It is equipped with four machine guns that are fired through small loopholes



At right, view of the war tank made from an Army truck for use in China. In this picture, the hinged top plates are open to let the soldiers enter

Through a tube running up the back of this boot, a bicycle pump forces air into the heel and sole so that walking is made much easier

NEW PIPE-LINE JOINT PREVENTS LEAKS



LEAKS in high-pressure lines carrying steam, oil, gas, water, or air are said to be prevented by the use of a new type of connection for sections of pipe. Instead of providing a single seat, the new union has two serrated ends, one hard and one soft, that form four distinct seats. The unions may be attached and disconnected repeatedly without spoiling the seats, providing economy in maintenance. In the photograph at left, one of the unions is shown dismantled to reveal the serrated edge, to which the pencil is pointing.

PNEUMATIC BOOTS LET WEARER WALK ON AIR

WALKING on air becomes a fact with the invention of pneumatic boots, recently exhibited in England. To increase the wearer's comfort, the sole and heel are provided with elastic air cushions. These are inflated through tubes that extend up the back of the boots, as shown in the cutaway model above, using an ordinary bicycle pump.

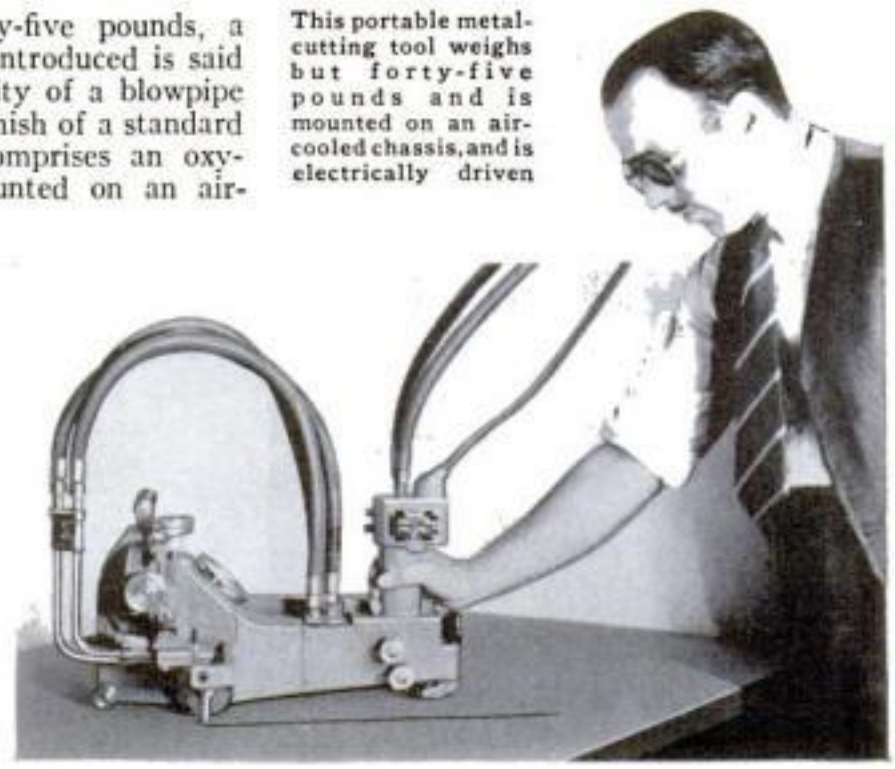
CIGARETTE PACKAGE IS OPENED BY THIS HOLDER

SERVING the dual purpose of opening a pack of cigarettes and holding the pack after it is opened, a handy appliance for smokers has just been placed on the market. When the pack is slid endwise into the holder, a sharp knife edge severs a strip of the wrappings on the top. When a release button is subsequently pressed, a hinged section springs up as illustrated at right, lifting the wrappings and exposing the cigarettes. When closed it affords them adequate protection.

PORTABLE CUTTING TOOL HAS MANY USES

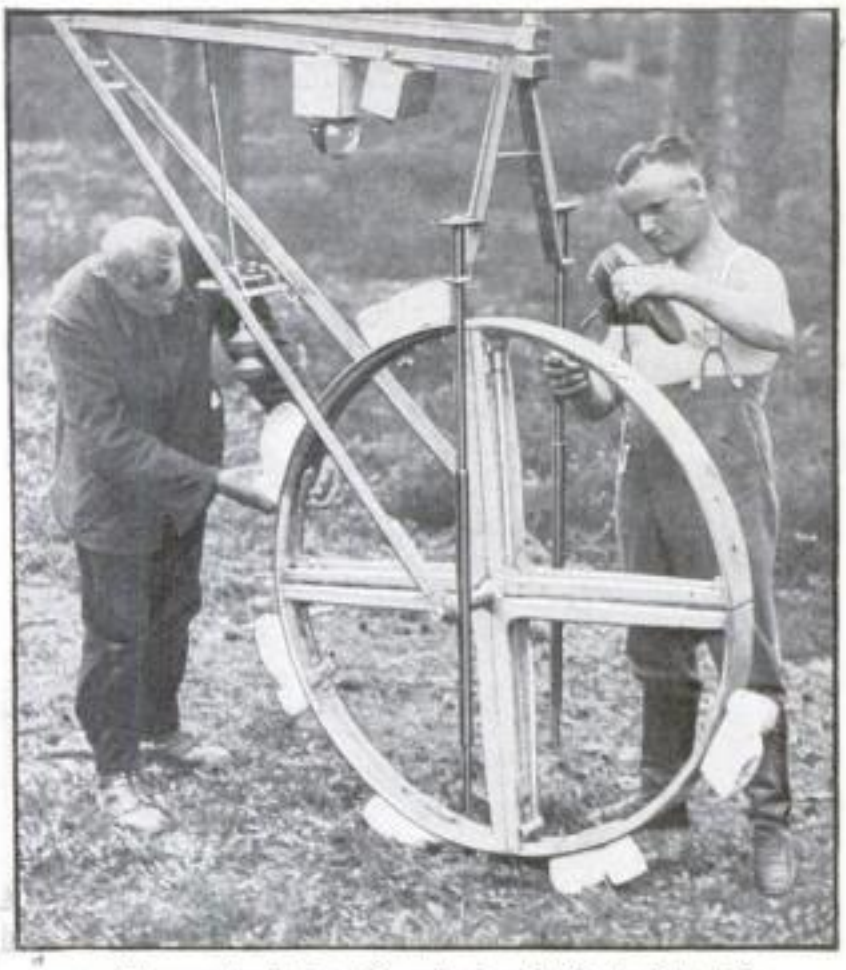
WEIGHING only forty-five pounds, a metal cutting tool just introduced is said to combine the portability of a blowpipe with the accuracy and finish of a standard cutting machine. It comprises an oxy-acetylene blowpipe mounted on an air-cooled chassis, electrically driven, which may be operated automatically on a track for cutting straight lines or guided across the work by hand for cutting simple shapes. An attachment adapts the device to cut circles automatically. According to the makers, the tool will find many uses.

This portable metal-cutting tool weighs but forty-five pounds and is mounted on an air-cooled chassis, and is electrically driven



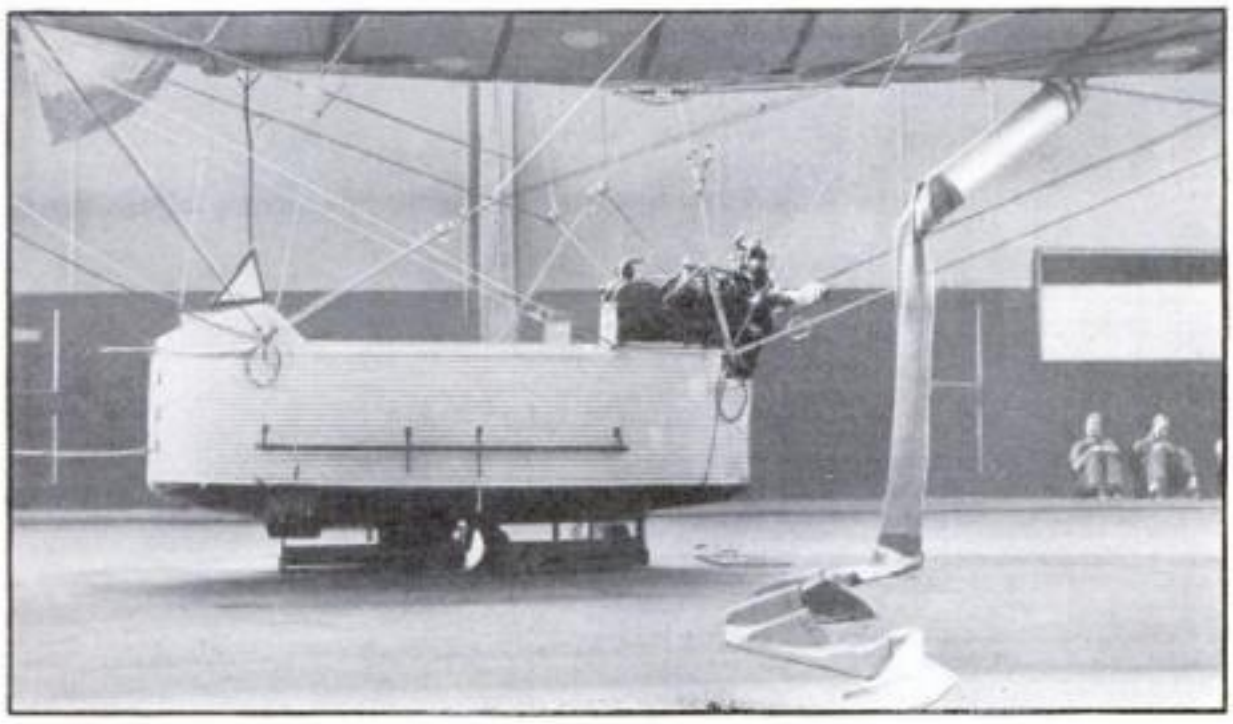
Put Shoes on Wheel to Train Police Dogs

FOOTPRINT wheels, devised by French police officials, have enabled them to prove that a police dog follows a fugitive's trail by scent alone, and not by sight. Models of a shoe were mounted on the rim of the wheel shown at right and it was drawn along the ground, thus leaving realistic-looking footprints. Police dogs were unable to follow this track. They had no difficulty in picking up the scent, however, when a pair of old shoes were placed on the wheel. The footprint wheel is proving useful in training the dogs to follow an odor, since the trail it lays is free of other footprints.



Shoes, attached to this wheel, make footprints with which the French are training police dogs. At the left, dogs are seen on trail, following footprints

USE MOTOR TO FLY ARMY BALLOON



BY MOTORIZING an observation balloon, Army Air Corps officers at Scott Field, Ill., recently conducted a successful experiment in increasing its mobility. After having flown from a cable in the usual way, the balloon was hauled to the ground and the improvised power car shown at left was added. Under its own power, as above, it then flew to other observation points and moored at a distant mast. Hitherto an observation balloon has had to be towed by a ground vehicle.

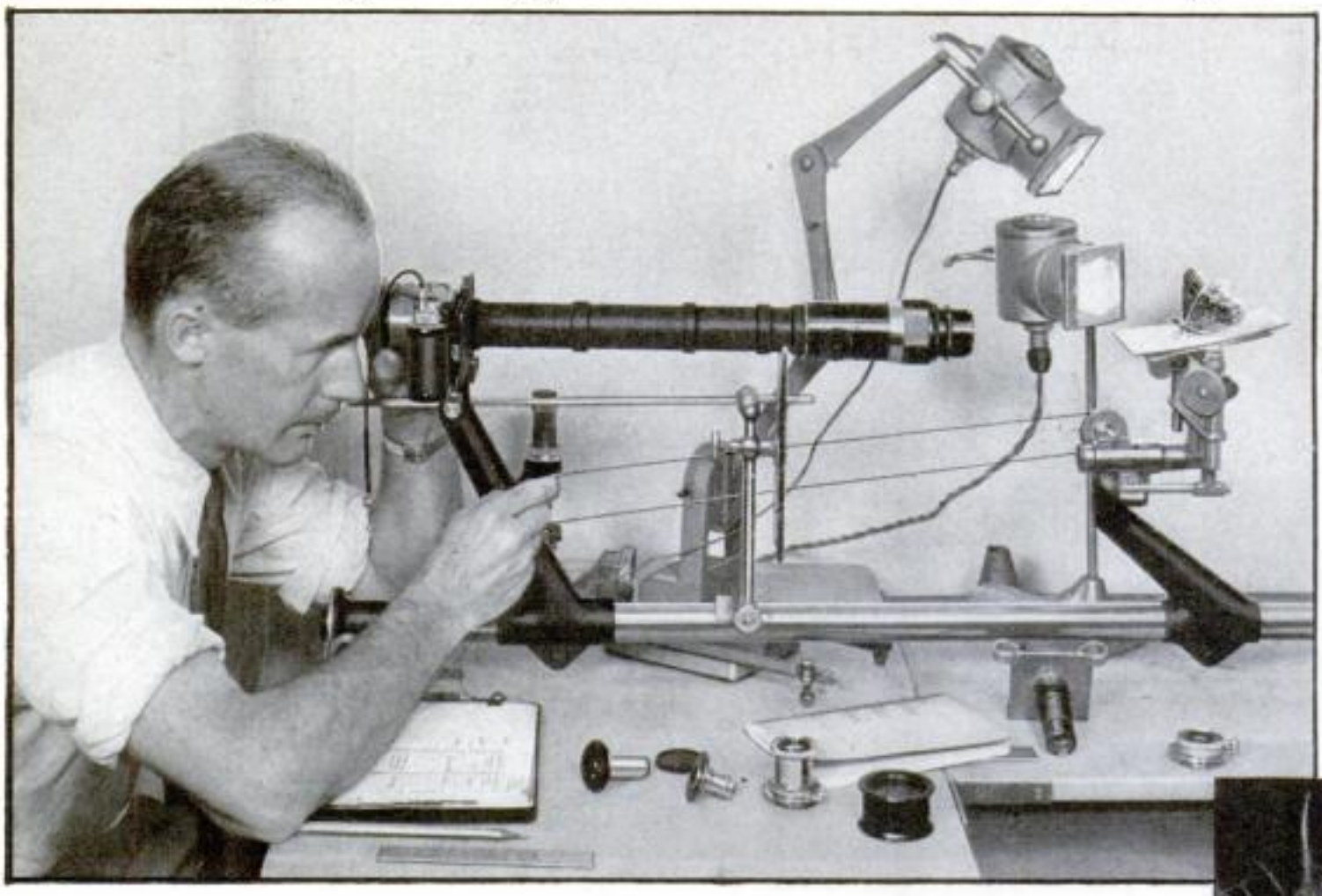
GIANT CRABS TURNED INTO FERTILIZER

KING crabs, a giant form of shell fish, bring new revenue to enterprising fishermen along the eastern coast. Unedible and otherwise useless, these sea creatures are now sold to thousands of farms as a highly improved fertilizer. Dried and pulverized, they contain more than fourteen percent ammonia. The powder, resembling ground coffee, is said to retain its strength twice as long as any common fertilizer. Large pounds or cages arranged in shallow water in the spring of the year trap the crabs. At low tide, the day's catch is transferred from the traps to large open bins to dry. After three months, the shells are ground, bagged, and placed in covered sheds to age.

Thousands of King crabs, one of which is shown at the left are piled in this open bin to dry, before being sold for fertilizer

Photographing Insect Monsters, His Hobby

Telephone Supervisor Designs New Set-up to Use With His Tiny Camera



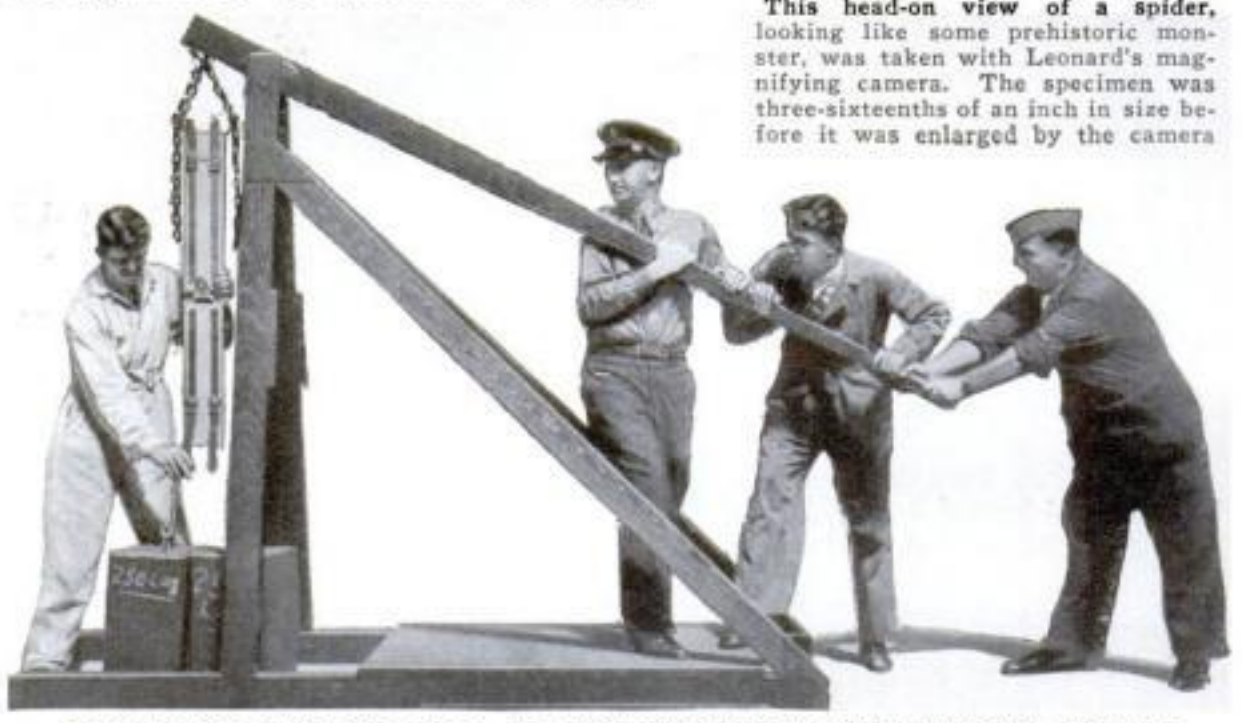
By means of the extension tube attached to his camera, left, James A. Leonard, of the American Telephone and Telegraph Company, New York City, secures the desired magnification so he can take pictures of tiny insects

This head-on view of a spider, looking like some prehistoric monster, was taken with Leonard's magnifying camera. The specimen was three-sixteenths of an inch in size before it was enlarged by the camera

MAKING photographs of insects enlarged to monster size is the spare-time hobby of James A. Leonard, general supervisor of long-lines service at the New York office of the American Telephone and Telegraph Company. He uses a set-up, devised by himself, consisting of a miniature camera using motion-picture film, fitted with a long-extension tube and lenses to give the required degree of magnification. When these have been chosen for the subject in hand, Leonard places his specimen on a small platform in front of the camera and moves it back and forth by means of an endless cord in his hand, as shown in the picture, until examination of the ground-glass with a magnifying lens shows the desired parts exactly in focus. Moths, spiders, and other interesting members of the insect world take on the form of gigantic creatures before this unusual array of apparatus, with which Leonard has assembled a remarkable collection of natural-history pictures believed to be virtually the only one of its kind. While this is only a hobby with Leonard, he has become an expert at the work and many of his pictures are unrivalled for clarity of detail and interest of composition, facts that are apparent in the picture at the right.

WINDSHIELD AND WIPER FOR MOTOR CYCLISTS

FOR use by motor cyclists in stormy weather, a new helmet goes far toward providing the comforts of a closed car. It comprises a waterproof hood with a built-in windshield, divided in two parts so that the top may be raised or lowered at will. As the window may be obscured by rain, a windshield wiper is provided.



SAFETY BELTS FOR ARMY FLYERS GET RIGID TEST

BECAUSE modern pursuit tactics place excessive stresses on safety belts, pilots of the 478th Pursuit Squadron Reserve, at Long Beach, Calif., test their belts at frequent intervals. The safety belt with its hangers is removed from the airplane and placed in the testing machine shown above. One end is connected to the short end of the lever, and the other to the weights at the bottom. When the long end of the lever is depressed, the safety belt lifts the weights attached to its lower end. The belt must be capable of supporting a load of five hundred pounds.

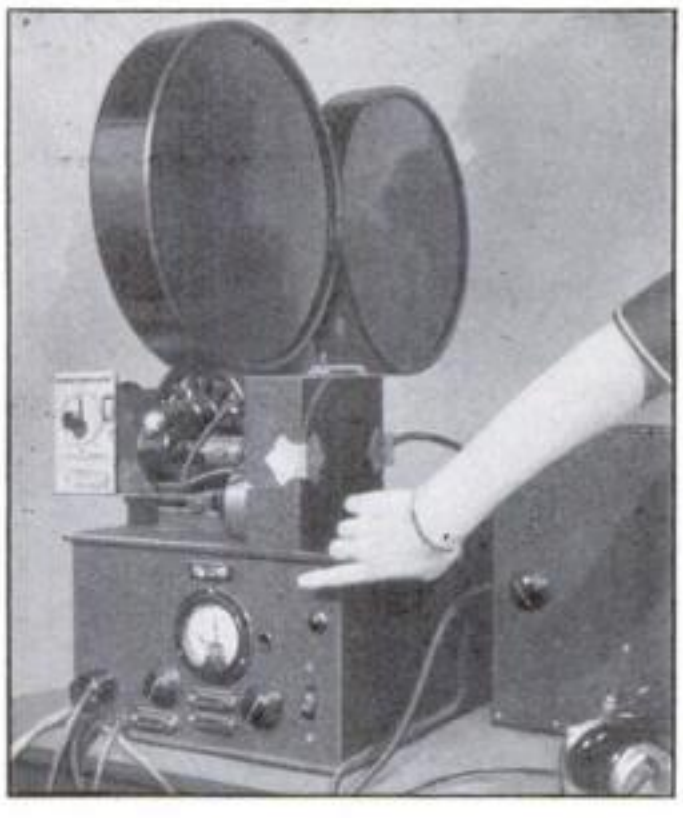
NEW PLANE HUNTS SUBMARINES

AN AERIAL submarine chaser, first of a fleet of four that will patrol the Mediterranean, has just been completed at Brough, England. Its wartime mission is to find and destroy hostile undersea craft with a gun that fires one-and-a-half-pound projectiles as rapidly as 100 a minute. Fed into the gun in clips of five, these shells would easily pierce the thin armor of a submarine caught near the surface. The gun is operated from the forward cockpit of the huge plane, which has a wingspread of ninety-seven feet, a speed of 132 miles an hour, and a cruising radius of 1,500 miles, making it a destructive weapon in time of war.

In the cockpit of the big plane, this gun is mounted. It fires 100 shots a minute that pierce armor

This huge plane, seventy feet in length and ninety-seven feet across the wings, is designed to chase and destroy submarines

3,000-FOOT FILM FOR RADIO PROGRAM



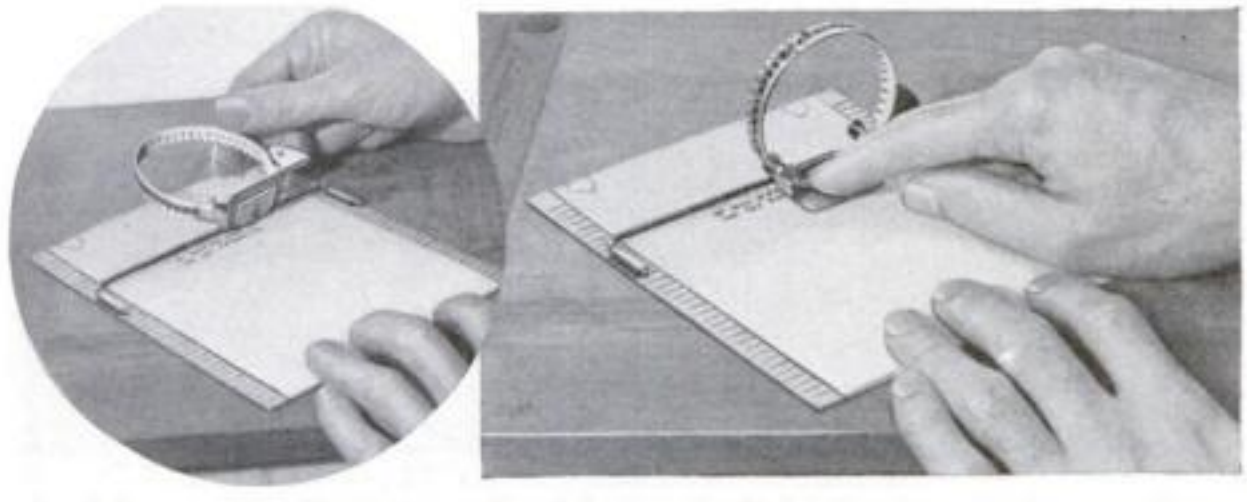
BROADCASTING a continuous twenty-four-hour radio program from a record prepared in advance, is made possible, it is said, with apparatus devised by Clifton R. Skinner, young San Francisco inventor of motion picture equipment. The record is made on a 3,000-foot roll of film, no larger in diameter than the standard fifteen-minute transcription disk now employed for canned programs. Since the entire film is utilized for sound, as many as twenty sound tracks can be put on each strip, and the reproducer, illustrated at left, will automatically jump to the next sound track when one is played through. Thus the apparatus removes the need of changing records every few minutes, and suggests the possibility of robot broadcasting stations operating virtually without the intervention of a human hand.

ILLUMINATED SLIPPERS FOR USE AT NIGHT

ILLUMINATED slippers now protect the person who arises in the night from the danger of stubbing his toe or falling downstairs. A flashlight bulb, mounted at the front of each heel, as shown above, casts a helpful beam ahead each time the wearer takes a step. The lamps operate on current from small dry cells in the heels. The slippers are sold already equipped with the light and battery. A shield at the bottom and in front guards the bulb so it is not easily broken in case the heel is accidentally struck against something or the shoe dropped.

SIMPLEST TYPEWRITER HAS LETTERS ON A RING

SIMPLEST of all typewriters, an inexpensive new toy for children consists of a metal band on which the letters of the alphabet are embossed. Rotating the ring cause the letters to pass over an ink roller. When the desired character is in position, it is pressed down and makes an impression on the paper. By moving the roller along a guide that is provided, it is easy, according to the maker, to produce neatly typewritten letters that have the appearance of having come from a standard machine.



In circle, typewriter tipped over to show hole through which letters are printed as seen above

Inventions *for* HOME-MAKERS

MODERN KITCHEN
Skilled engineering, designed for home needs, arranged the electrified equipment in the kitchen, above. Note the electric refrigerator, near the entrance, then a table for preparing food, dishwasher, sink, table, and electric range. Left, clock to control cooking time

VACUUM CLEANER EASY TO STEER
A twist of the wrist revolves a handgrip that in turn steers the pivoted head of the cleaner seen at right. Thus it is guided as desired without swinging cleaner around

SET OF FOUR MEASURING CUPS
These nested cups are of various sizes, each cup holding a definite amount. With the set it is possible to measure a full cup, three fourths of a cup, half a cup, or a quarter of a cup, simply by selecting the appropriate size

HANDY TOASTER. Pressing a lever raises the top of this toaster, as illustration shows, so it is easy to sweep out the crumbs. Also opening the doors, turns toast over

EGG OPENER AND SERVER
An egg, placed in the hinged double-cups above, is neatly opened. It is then eaten directly from the opener, as shown

Sea Tractor to Save Wrecked Ships

Machine Walks on Bottom of Ocean

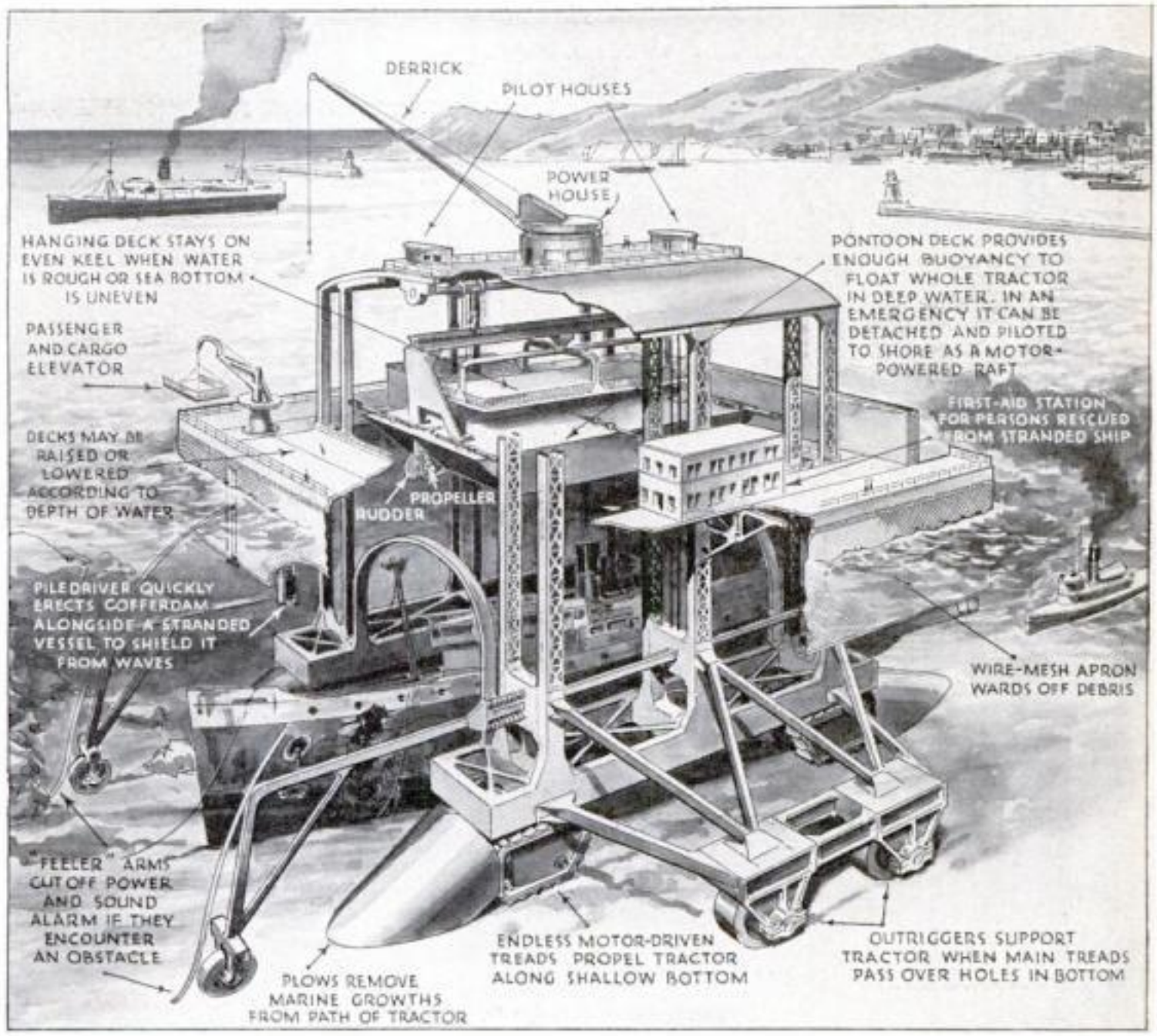


Illustration shows sea tractor as it would be used in salvaging a wrecked ship that had sunk in shallow water

DESIGNED to aid stranded vessels, and to help in salvaging the cargo of sunken liners, a marine emergency tractor of sky-scraper dimensions has been designed by a New York inventor. Large enough to straddle a good sized ocean-going ship, the U-shaped frame of the tractor is propelled along a shallow bottom by endless, motor-driven treads. Above the frame, a pontoon deck gives the apparatus enough buoyancy to float in deep water, while other decks provide facilities for rescue and salvage work. Removing the passengers and crew of a vessel that has run aground would be an easy task for this monster machine, its inventor maintains, since it may be maneuvered as independently of marine topography as is any army truck on land. The tractor pilot has simply to bring his vehicle in position over the ship as shown by our artist on this month's cover, and the survivors are hoisted aboard with derrick-powered elevators. If the ship is in imminent danger of breaking up, a cofferdam of piling is laid by the rescue machine on the windward side. Because of its maneuverability on the sea bottom, the tractor would also be an effective base for salvage operations on sunken wrecks, as is clearly shown in the diagram on this page.

Unique collection tells history of lamps used in all ages

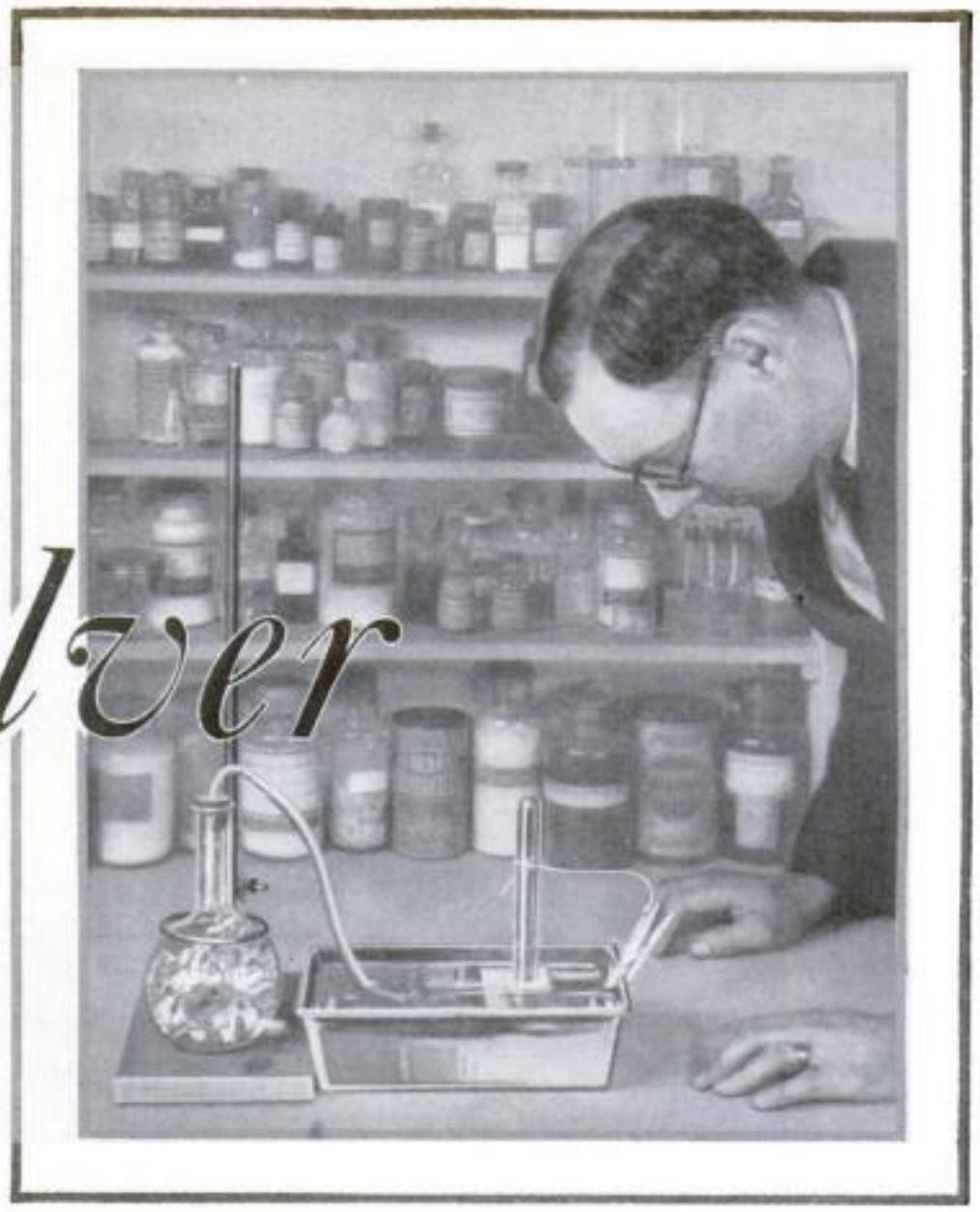
EXHIBIT TELLS STORY OF ARTIFICIAL LIGHT

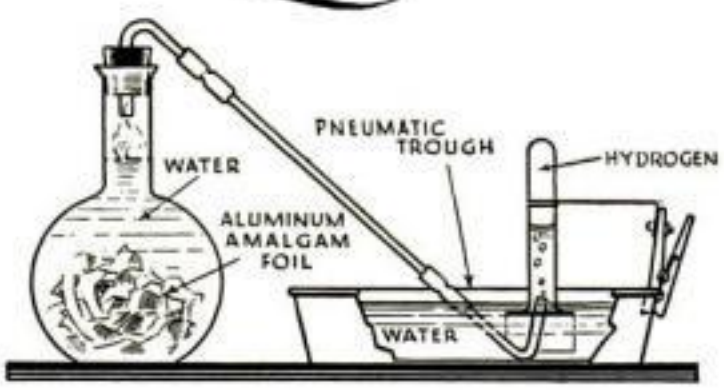
AN UNUSUAL exhibit of lighting devices, new and old, is being assembled by Dr. Walter Hough, of the Smithsonian Institution. Starting with the light of the first fire, made by rubbing sticks, his collection recalls such odd facts as that Shetland Islanders, within the memory of living inhabitants, inserted wicks in the fatty bodies of dead petrels and used the birds for light, while dogfish and suckers have similarly been employed by Indians and fishermen of New England. Early Pilgrims, for want of candles, used rushlights, which were made of the pith of rushes dipped in grease.

INK VISIBLE IN THIS PEN

A FOUNTAIN pen recently placed on the market, will never annoy its owner by unexpectedly running dry. The barrel is transparent, and the level of the ink within it is plainly visible at all times, reminding the user in advance when it needs refilling. A decorative striped finish on the exterior of the pen is applied in such a way that it does not interfere with the view of the barrel's contents, as shown in the accompanying photograph. The pen is filled in the ordinary manner by working a suction plunger. Frequent fillings, it is said, do not discolor the barrel of the pen so as to render the contents invisible.

Unusual stunts you can do with *Freakish Quicksilver*





Aluminum foil, which has been treated with a bichloride of mercury solution, is immersed in a flask of water. The aluminum combines with the oxygen in the water and frees the hydrogen which is collected in the test tube. At left, diagram showing arrangement of apparatus needed to make this experiment

MERCURY, a liquid at ordinary temperatures, is the strangest of all metals and hence offers the home chemist many interesting and enlightening experiments.

Examine a bit of the bright, silvery substance. You will find that it has a strong tendency to scatter into tiny droplets. From this property, the metal obtained its common name of "quicksilver."

Considered on the basis of volume, mercury is an expensive metal. For twenty-five cents you will obtain only a small vialful. In weight, however, it is quite reasonable, for few metals weigh more for a given volume.

You can demonstrate this by dropping various metal articles into a pool of mercury. Iron, steel, tin, brass, copper, and zinc will bob around on its surface like corks in a pool of water. Gold, on the other hand, being heavier than mercury, will sink in the strange liquid.

Before dropping one of your best gold trinkets into the mercury, however, you must protect it by coating it with a thick layer of cold cream or heavy oil. If this is not done, the mercury will alloy with the gold to form a tenacious coating that will be difficult to remove.

In fact, mercury will alloy in this way with many metals. The chemist calls the coating an amalgam and the mercury is said to amalgamate the metal. It is this queer property that has made mercury a valuable aid in gold mining. Impure gold, ore, and gravels mixed with mercury immediately form a gold amalgam. When this is heated, the mercury distills off leaving the pure gold behind. Similar dissolving processes or amalgamations are possible ordinarily with every metal but iron, and under special conditions even iron succumbs to mercury's action.

In the amalgamation of mercury with aluminum, the home chemist will find a spectacular experiment. Spread out a small sheet of ordinary aluminum foil of the type used to wrap candy bars or photographic films on your laboratory bench. Then using a stick or a small brush, paint a surface of the foil with a saturated solution of mercuric chloride (bichloride of mercury, not the dilute solution sold as a germicide). Make letters or insignias or cover the foil completely with the liquid. This will coat the aluminum with mercury.

Immediately the foil will take on a frosted appearance. A white fluffy growth will form on the treated surface, crinkly noises will be heard, and wisps of steam will rise from the substance. In time the fluffy fur will become at least a quarter of an inch thick. When left over night, the fur often becomes coated with a wisp-like web that enhances the strange effect. Chemically speaking, this mysterious growth is aluminum oxide.

As a word of caution, the amateur must bear in mind that bichloride of mercury is a deadly poison. However, it can be used safely and sanely if the experimenter will handle it carefully and take care to keep it away from his mouth. To be on the safe side, wash your hands repeatedly when using it.

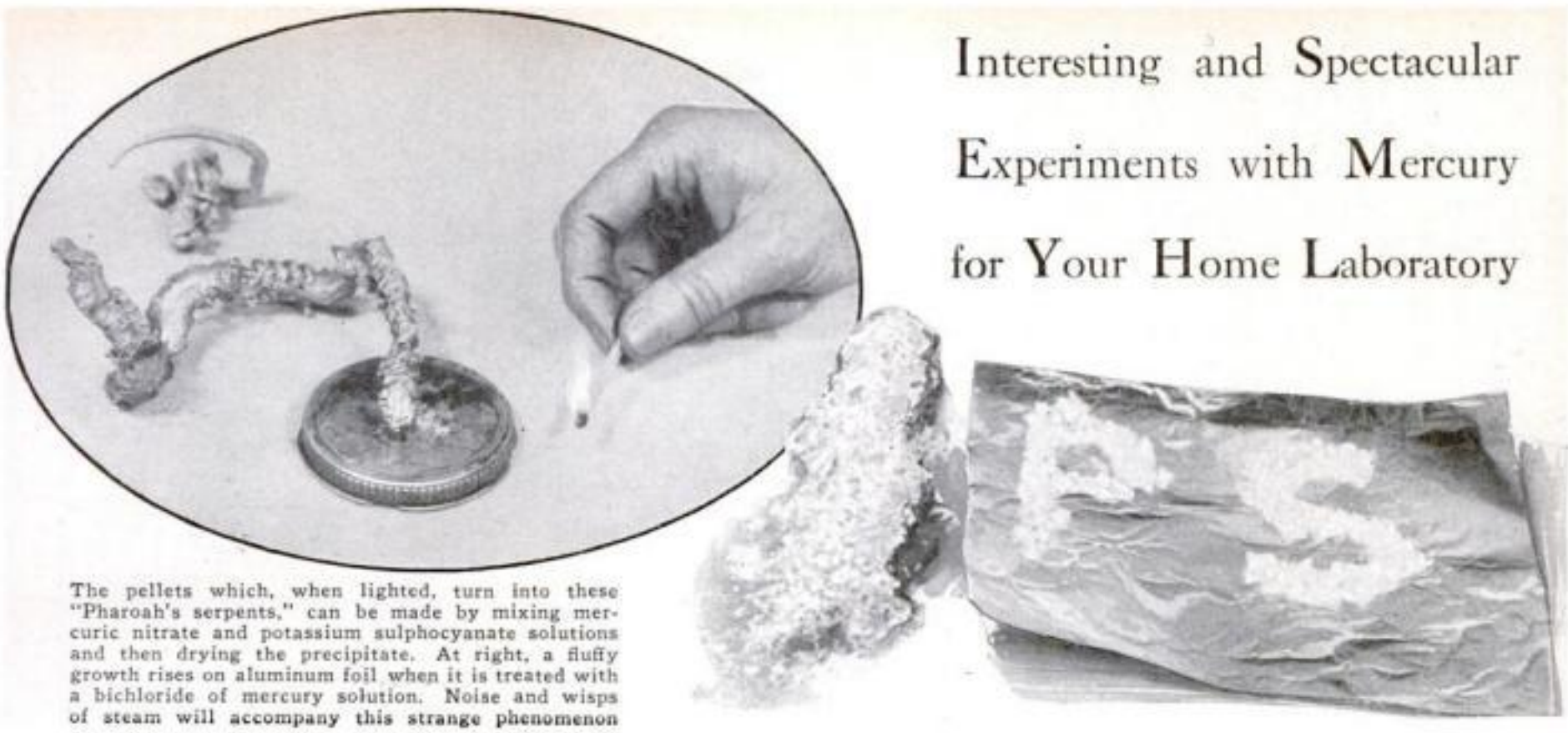
As a second experiment along the same line, roll a sheet of the aluminum foil into a loose bundle and, supporting it on a wire, lower it into the concentrated bichloride of mercury solution. The mass

Weighing Chemicals with Money

A HALF DOLLAR	=	200	GRAINS OR	12.50 GRAMS
A QUARTER	=	100	" "	6.25 "
A NICKEL	=	80	" "	5 "
A DIME	=	40	" "	2.50 "
AN OUNCE	=	437.50	GRAINS	

Therefore, Two Half-Dollars and a Dime Combined Serve as a One-Ounce Weight

Interesting and Spectacular Experiments with Mercury for Your Home Laboratory



The pellets which, when lighted, turn into these "Pharoah's serpents," can be made by mixing mercuric nitrate and potassium sulphocyanate solutions and then drying the precipitate. At right, a fluffy growth rises on aluminum foil when it is treated with a bichloride of mercury solution. Noise and wisps of steam will accompany this strange phenomenon

By

R*aymond* B. W*ailes*

of amalgam formed when the growth starts will be so great that considerable heat will be generated.

Aluminum foil treated in this way will perform an equally startling feat by liberating hydrogen from ordinary water. The oxygen in the water unites with the aluminum to form aluminum oxide and the hydrogen gas is set free.

To produce a slow but steady stream of hydrogen by this process, stuff a large wad of untreated aluminum foil into a bottle or a chemical flask. Pour some of the saturated bichloride solution into the bottle and shake it well to make sure that the solution reaches all parts of the foil. Then pour off the mercury solution and fill the flask with water.

TO collect the hydrogen given off, arrange the apparatus as shown in the photograph. Insert a cork fitted with a delivery tube into the neck of the flask, invert a test tube of water over the shelf of the collecting trough recently described (P. S. M., June '33, p. 48) and, after waiting for the first few bubbles of the gas to clear the system of air, place the end of the delivery tube under the inverted mouth of the water-filled tube.

When the test tube is completely filled with the gas, place your thumb over its mouth, and remove it from the trough. Then removing your thumb, quickly bring a lighted match or splinter up to the opened end. The harmless "plurping" explosion that results will be a fairly good sign that the tube contained hydrogen.

For the next experiment, you will need enough mercury to form a small pool or flattened drop. Carefully pour a little dilute sulphuric acid on it and then add a drop of potassium-permanganate solution. Your drop of mercury will take on a faint purple color.

Touch one edge of the drop with the tip of an iron wire or needle. To your surprise, the drop will shrink or "ball up." As it pulls away from the iron, it will flatten out only to come in contact with the wire again and immediately contract into a ball. This rhythmic motion will continue for some time.

If a potassium-dichromate solution is used in place of the potassium permanganate, streamy clouds of precipitate will be found as the mercury pulls away from the iron.

After using the mercury for several of these experiments, it is best to shake it vigorously with weak nitric acid (a five per cent solution) to free it of some of its impurities. The nitric acid can be removed easily by shaking the mercury with water.

Another experiment of a similar nature can be performed by covering the mercury drop with a solution of ordinary table salt and placing a crystal of copper sulphate on top of the drop. When this is touched with an iron wire, the crystal will immediately jump toward the wire and then skip over the surface of the mercury leaving it extremely bright. After a time, when the mercury contains too much copper, the motion will cease.

By mixing solutions of mercuric chloride and ammonium oxalate, the amateur chemist can make a light-sensitive liquid that can be used as the basis for any number of interesting light experiments. Kept in the dark, the solution will remain colorless, resembling ordinary water. A short exposure to light, however, will cause it immediately to cloud up; a white precipitate being formed. Even a half hour's exposure to a lighted, low-wattage lamp will cause a marked whitening.

So sensitive is this solution to light, that it can be used to measure accurately the relative intensities of different light sources. By analyzing the solutions before and after the exposures, a numerical gage of the light intensity can be obtained.

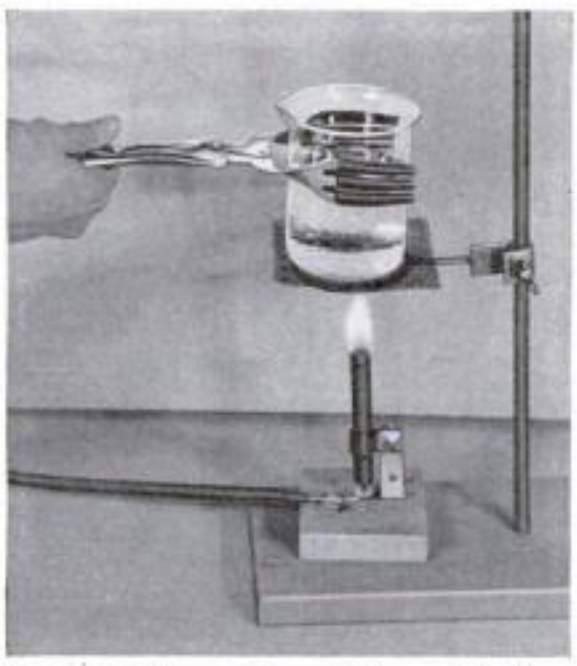
With a few chemicals, the experimenter can compound a peculiar substance that on burning produces large quantities of fluffy ash. Molded into pellets, this substance is sold on the fourth of July as "snakes in the grass."

To make your own pellets, prepare a solution of mercuric nitrate by dissolving the chemical in warm water. Also, make a similar solution of potassium sulphocyanate. Add several drops of iron-chloride solution to the mercuric nitrate and then add some of the potassium-sulphocyanate solution. As the white precipitate forms, stir it well and then allow it to settle.

Continue adding the potassium-sulphocyanate solution in small quantities until the entire mixture turns red or pinkish. This sign, furnished by the iron chloride in the mixture, is a visual indication that the reaction has been completed. If the red color slowly fades, add more potassium sulphocyanate.

The precipitate formed then should be washed by decantation (P. S. M., Nov. '33, p. 54), spread out on a sheet of glass to dry, and molded into small pills or pellets by ramming it into a round tube. To ignite one of the pills, place it on the tin top of a mayonnaise jar or can and bring a lighted match to its upper end.

HANDY TONGS

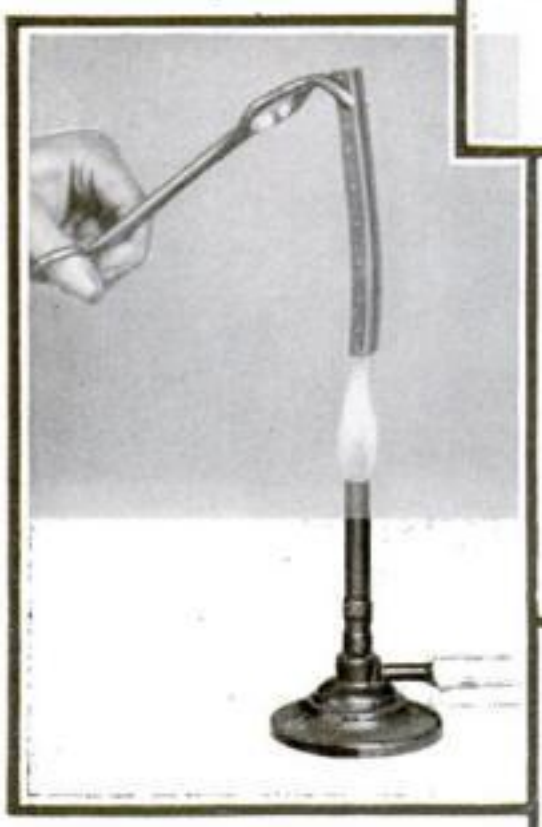


TONGS with which to lift hot beakers, are easily made out of an ordinary potato lifter. The prongs of the fork are covered with rubber tubing to prevent them from slipping when beaker is grasped

Home Tests of Scientific Facts

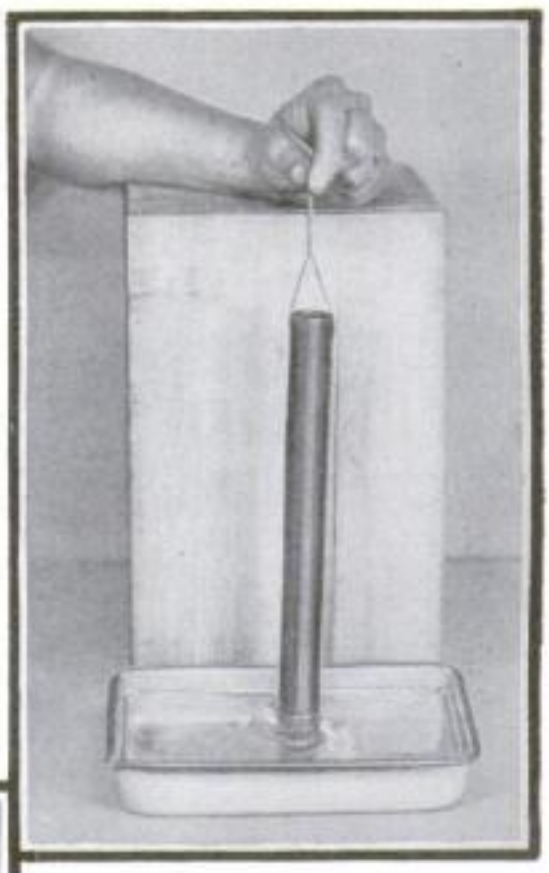
To make this embroidery hoop roll up hill attach a turn or two of wire solder to the forward edge of the rim. This throws the hoop's center of gravity above and ahead of the point of support. The hoop will roll up hill as it tends to lower the actual center of gravity

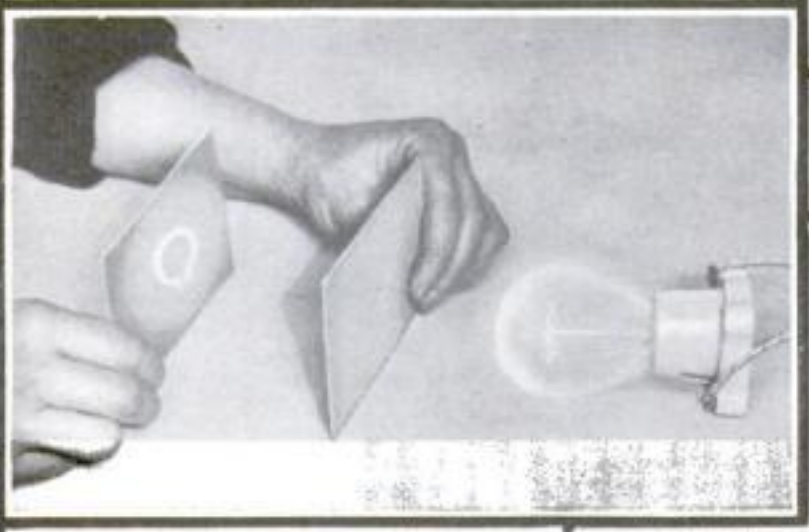
Surprisingly little apparatus is needed to perform a number of interesting experiments, illustrating natural laws. For instance, at the right, a tube of iron filings has been magnetized by drawing a magnet over it, and it will then attract a compass needle. Shaking the tube causes the magnetism to vanish because the iron particles in the tube are thrown out of alignment and no longer behave as a single large magnet



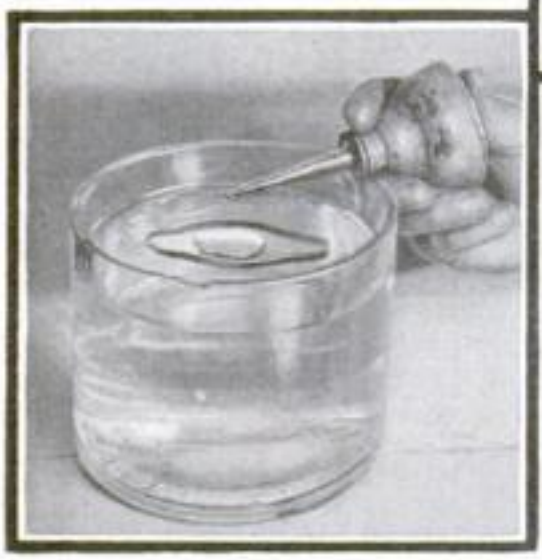
Metals expand when heated, but they do not all expand to the same amount. At left, you see what happens when a strip of iron is riveted to a strip of brass and then heated. The difference in expansion of the two metals, bends strip into an arc

At right is a simple form of water turbine made of a cardboard tube corked at the bottom. Two holes are punched slantwise near the bottom as shown below. When the tube is filled with water and suspended by a string, it will revolve due to the recoil from the jets of water spurting out sidewards from the holes. This demonstrates the law that for every action there is an opposite and equal reaction present





The tendency of the film of a liquid to contract to the smallest possible area is called surface tension. To test this, let a drop of oil fall inside a rubber band floating on water. The greater surface tension of water will draw the rubber band into nearly a perfect circle



Above, an experiment to prove that a pinhole in a card acts like a lens. Light rays from any point on the electric bulb, passing through the pinhole, can fall only on one spot of the screen. As a result, a perfect, inverted image of the filament can be seen clearly outlined on the screen

Coal gas is formed when coal is heated with insufficient air for combustion. Similarly, "paper gas" can be made by rolling a newspaper as shown at right and lighting the lower end. Gas issuing from the upper end of roll, burns when lighted

FINDING THE SOURCE OF
Mysterious Radio Troubles

Rattles in a radio may often be traced to the vibrations caused in vases and other things that are resting near the loudspeaker cabinet

By George H. Waltz Jr.

RECENTLY a radio repair man answered a call from one of his customers. The radio, he was told, had suddenly developed the mysterious habit of shutting off the moment a near-by chair was used.

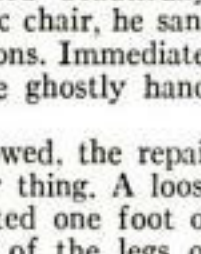
Doubting the story, the service man flicked the switch on the side of the cabinet and tuned the set to the loudest station. The outfit performed beautifully. Striding over to the mystic chair, he sank into its comfortable cushions. Immediately, as if silenced by some ghostly hand, the radio stopped.

In the search that followed, the repair man discovered a peculiar thing. A loose board in the floor supported one foot of the chair as well as one of the legs of the radio cabinet. The slightest added weight in the chair lifted the opposite end of the floor board, raising one corner of the radio cabinet, and twisting the receiver chassis.

Continuous twisting had broken a soldered connection inside the set. After that, the slightest movement of the chassis pulled the wires apart and opened the circuit.

This is only one example of the many strange, almost inexplainable things that can happen to a radio. Not all troubles can be traced to cut and dried causes such as poor tubes or faulty parts. In fact, it is the out of the way trouble that is the easiest to fix but the hardest to locate.

Many times the real seat of the trouble is far removed from the set itself. For example, every rattle and rasp that issues from a loudspeaker is not due necessarily to some defect in the cone or unit. In many cases, especially on the lower notes, troublesome rumblings can be traced to vibrating ornaments and other bric-a-brac that adorn the cabinet top or near-by tables. If your speaker rattles, always make a few tests by removing any objects that may vibrate.



If you are sure the rattle is not from some outside source and the speaker diaphragm appears tight, inspect the cone near its center. Often a slight buckling will cause speaker noises that are hard to trace to their source.

Even chassis parts can be the cause of many speaker noises. Loose-fitting coil and tube shields in particular have been found to cause many types of crashings and sputterings that mar reception. To make sure that your shields fit tightly, bend the rim of each base slightly out of round to insure good contact and prevent vibrations.

Loud crashes and scratchings blasting from your loudspeaker when you turn the tuning dial may mean nothing more than bent or dirty wiper arms on the condenser rotor. To provide a good contact and end the trouble once and for all, solder a flexible pigtail connection across the wiper arm and rotor.

A noisy volume control is not always a sign that the part must be replaced. The noise may be caused by nothing more mysterious than a piece of dirt that has worked its way between the resistance and the contact arm. Twisting the control back and forth over its full swing generally will free the dirt and stop the noise.

Every now and then a new radio ailment comes to light. Not so long ago, the writer heard of one that had stumped the owner of the set for some time. When first switched on, the receiver operated as it should. After five or ten minutes, however, it would go into violent oscillation. Weird howls and squeals would blot out the program.

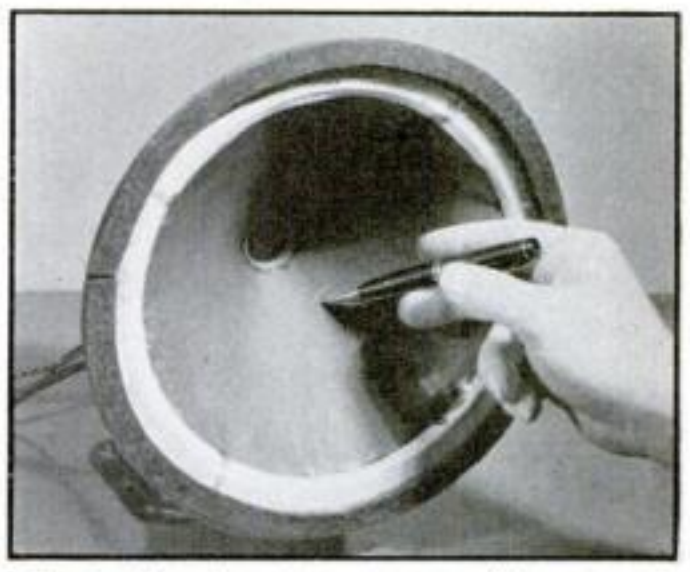
Suspecting the tubes, the owner took them to an expert service man. Much to his surprise, tests showed them to be in perfect condition and a careful inspection of the set failed to reveal any visible defect in the actual circuit.

When a radio acts as this one did, the trouble generally can be traced to the expansion of some part due to heat. A resistor or even the tiny elements in a tube after heating up may expand just enough to cause a short circuit or an open connection. Even premature tube failure, it has been found, can be caused by an expanding bias resistor that short-circuits on the metal receiver chassis.

Tubes may check perfectly when cold and still fail to give results when they heat up in actual use. For this reason, it is best to test tubes only after they have been allowed to heat up in the receiver circuit.

Although queer loudspeaker noises always mean trouble, it does not necessarily follow that the trouble is inside the set. Poor grounds, for instance, cause many noises that are blamed on a loose connection in the circuit. If you use a radiator for a ground and find that the loudspeaker chatters and sputters everytime you walk across the floor, inspect the piping. Jar the radiator to make it vibrate. Nine times out of ten, you will find that you can make the noise appear and disappear at will.

Ground noises of this type can be traced to some piece of metal that makes a rubbing contact with the radiator pipe. The most frequent offender is the metal lathing in the ceiling of the room below. If the piping touches it at any point, and vibrations cause the radiator to sway enough to make and break the contact, noises are bound to result.



The buckling line, almost imperceptible, pointed out above, may cause a rattle in your loudspeaker

Alternating current hum is another noise that often has its source in the ground circuit. To prevent it, trace through your ground. If it terminates in piping, find out what other electrical circuits are grounded to it.

As with the loose floor board, most mysterious ailments can be traced to some simple cause outside the receiver. Not long ago, an excited customer rushed into a radio service station and explained that his radio refused to work. Although it had been working perfectly only the night before, even the usual noises were lacking when he switched it on again twelve hours later.

After several tests, the service man inspected the power plug—one part that he knew was an old offender where mysterious troubles were concerned. In this case, however, it proved to be in perfect order and it was not until a bridge lamp, plugged into the wall receptacle, failed to light that the real trouble was discovered. In some way, the house fuse supplying the circuit had been blown.

Recently another radio enthusiast complained that his set had developed a steady grinding and scratching. Being an experimenter, he tried several tests. Disconnecting the antenna, he found that the noise stopped.

Offhand, following the general rules, this would tend to indicate that the noise

When inspecting your set, remember that loose shields can cause trouble

was man-made static from some near-by piece of electrical machinery.

This particular mystery was not cleared up until a thorough inspection was made. Again, the set was not at fault. A careful search showed the cause to be a poorly soldered joint at the connection between the lead-in wire and the antenna. Corrosion had crept into the loose joint and the wind, swaying the wire to and fro, had caused the scraping contact to set up a fine imitation of violent static.

In few cases where the trouble can be classed as "mysterious" it is necessary to rip the circuit apart to find the source. The amateur who services his own set can avoid unnecessary trouble and expense if he will go about his work with an open mind. Hunt out the obvious things first and suppress the desire to pull your set apart at the first sign of trouble.

NEW METHODS MAKE

Remote Control Popular

This remote control panel placed on the arm of a chair, operates every function of the radio by pressing buttons

ALTHOUGH the idea of controlling a receiver from a distant point is not new, recent developments have revived interest in remote control.

Early attempts at long-distance tuning consisted of a series of push-button switches that operated reversible electric motors geared to the shafts of the receiver controls. Now, visual-tuning meters, kilocycle meters, and thermostatic-oscillator control have been added to bring remote control up to date.

With the modern remote-control panels shown in the photographs every function of a radio can be operated merely by pressing buttons and watching the dials of electric meters.

In one, a visual tuning meter supplements the usual array of buttons. With it, stations can be tuned quickly and accurately. Besides eight buttons that bring in preselected stations, two additional buttons allow the set to be tuned to any station on the air while the tuning meter indicates, by the swing of its needle, the exact point at

In this remote-control unit the portable case houses the tuning portion of the set

At right, remote-control panel with a visual-tuning meter that supplements the buttons. Below, a kilocycle meter that shows the frequency tuned

which the station is tuned to best advantage.

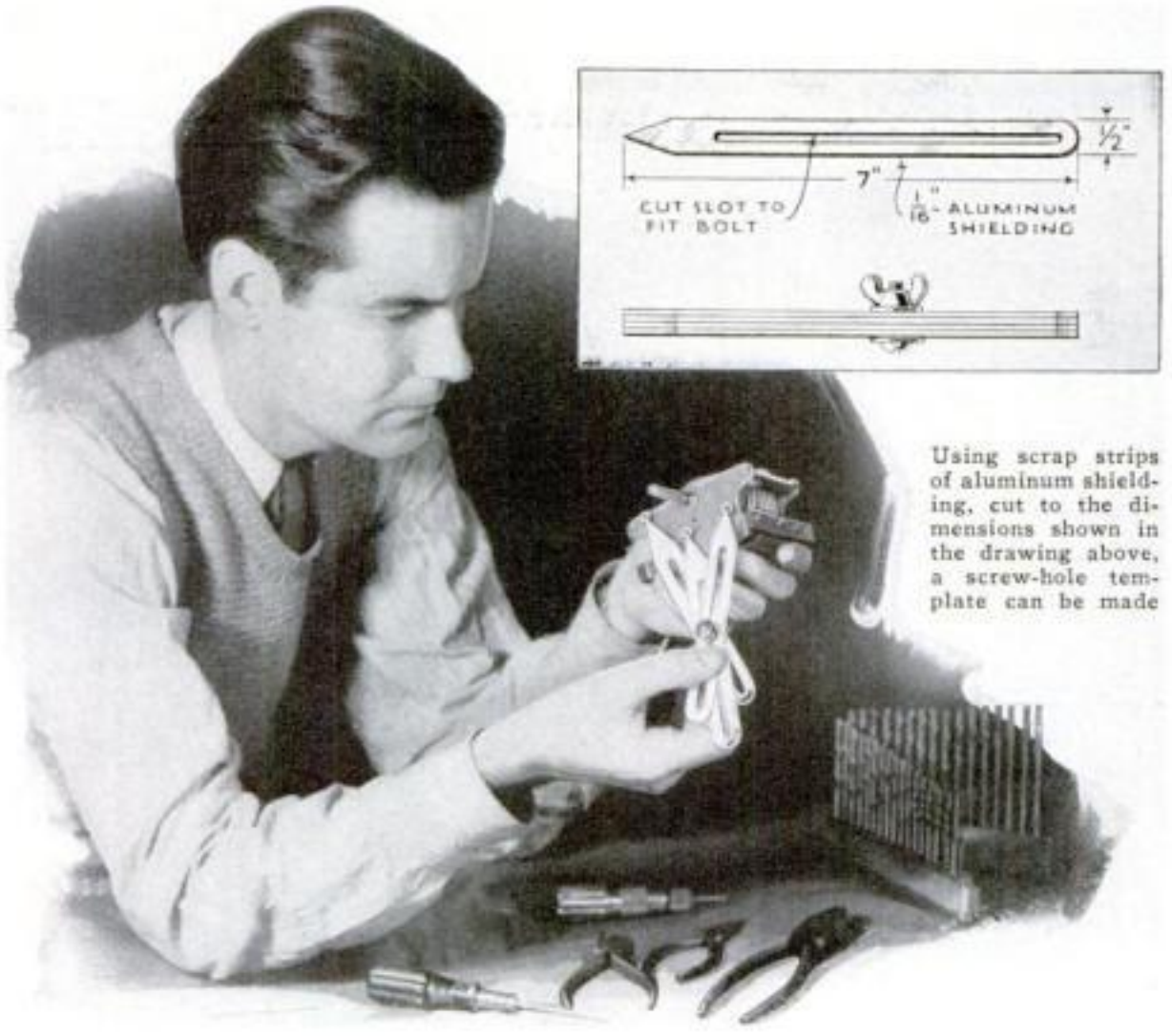
A kilocycle meter, that shows the exact frequency tuned in, as well as a visual-tuning meter, are featured on the remote-control panel shown directly above. With them, the receiver not only can be tuned accurately but stations can be located easily.

In one remote control system, the selector case itself contains the tuning portion of the radio circuit. Turning the dial just as you would the knob at the receiver, tunes the set. The amplifying portion of the receiver and the speaker are housed in the main cabinet which can be placed where desired. In this particular system, tuning switches and motors are eliminated.

Besides the usual controls, this particular panel also provides for tone control, allowing the pitch of the reproduction to be varied to suit the acoustical characteristics of any position in the room.

Short Cuts for Radio Builders

Practical Suggestions for the Amateur Made by Experienced Workers



Using scrap strips of aluminum shielding, cut to the dimensions shown in the drawing above, a screw-hole template can be made

AN ADJUSTABLE template that will make it easier for you to transfer screw-hole locations for condensers and similar parts to a panel or chassis can be made from scraps of aluminum shielding. As shown in the photograph and drawings, the template consists of three or more pointed aluminum arms fastened together with a short bolt and nut. Cut the strips about one-half inch wide and seven inches long. The slot, running the full length of each arm, should be wide enough to be an easy sliding fit for the fastening bolt. If a wing nut is used in place of an ordinary nut, the template can be adjusted easily by hand. To use the template, loosen the holding bolt and arrange the arms so their pointed ends rest on the approximate centers of the screw-holes in the part to be mounted. Then, when the template arms are locked in place by tightening the bolt, the center marks can be transferred by scribing around the points with a sharpened nail or a regular scriber.—W. P.

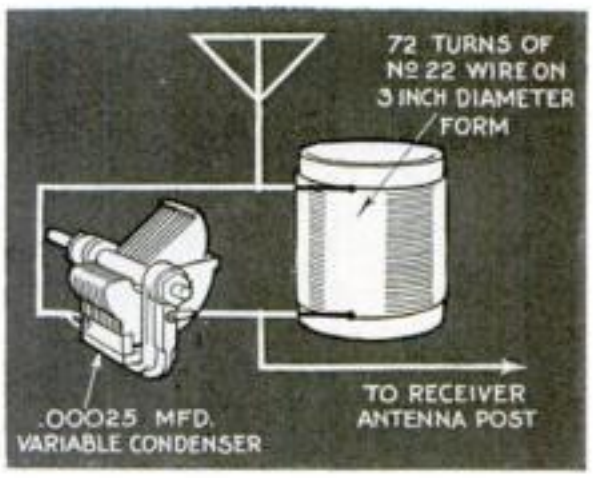
Homemade Cement for Use on Loudspeaker

A mixture consisting of half banana oil and half collodion makes a good cement for loudspeaker repairs

WHEN making repairs on a loudspeaker, the radio experimenter often is at a loss to know what type of cement is best suited for the work. A handy solution that is quick-drying, fairly elastic, and strong can be made easily by mixing equal quantities of collodion and banana oil. It is equally useful as a cement for fastening loose wires in place and as a coating for home-wound coils. In an emergency, liquid-nail polish also can be used but its cost is almost prohibitive when large quantities are needed. When storing any cellulose-base cement of this type, be sure to keep it air-tight.—B.W.

Using Your Tone Control

MANY radio owners do not use their tone control to best advantage. Although it is intended primarily for accentuating either the high or low frequencies as desired, it has many other equally important functions. The next time you are troubled with static, either man-made or natural, try adjusting your tone control. In nine cases out of ten, one particular setting will improve things. It is also useful as a quality balance when the set is tuned for low volume. Adjusting it to bring in the higher frequencies, generally will make up for any loss in quality. Don't set the control knob and leave it there. Try various adjustments for each program as you tune it in.—L. J. G.



Simple Wave Trap Ends Interference

ONE of the best ways to overcome interference from a near-by station that persists in spoiling reception over a large portion of the dial is to equip your set with a wave trap. One that is inexpensive and yet highly effective can be made from scrap wire and a spare condenser. It consists of a parallel-connected coil and condenser inserted in the antenna lead of the set. The coil, consisting of seventy-two turns of number twenty-two insulated wire, should be wound on a three-inch diameter form. The condenser should have a capacity of .00025 mfd. If a larger condenser is the only one available, decrease the number of turns on the coil. By trial and error, you can find just the right coil for any condenser. With the wave trap in place, tune the set to the best setting for the station you desire and then adjust the wave-trap condenser to eliminate the unwanted station. If the undesirable station is very close to the receiver it may be necessary to shield the wave trap with a regular metal shielding can.—C. H. S.

Stripping Insulation

BY CUTTING two shallow grooves in the jaws of your cutting pliers, you can use them for stripping the covering from insulated wire. Using a file or a sharp edged oilstone, form a V-shaped notch at the same point in each of the cutting edges. Make the grooves just deep enough to take the diameter of the wire. To skin the wire, place the end in the notch, close the pliers, and pull. If you have a pair of long-nosed cutting pliers, you can provide the jaws with grooves of various depths to take care of several sizes of wire. When the notches are placed at the inner ends of the cutting jaws near the joint, they do not spoil the pliers for ordinary cutting operations.—H. W. E.

"Plenty of gas. It can't be that," Gus said as he peered into the gas tank of the car that stopped and wouldn't run

Why Wouldn't This Car Run!

By

MARTIN BUNN

"CONFOUND it, now what?" Fred Steffins grumbled as he pushed the gear lever into second. "First time I've ever had to shift on this hill."

John Crae, who was sharing the front seat with him, leaned forward to get his ear nearer the dashboard. "Motor sounds sweet enough," he observed. "Maybe you gave it too much gas."

"Nope, it wasn't that," Steffins informed him. "I've noticed it several times this morning. You'd feel it if you were driving. The motor's sluggish; won't take the gas and hasn't any power. Think I'll stop and have a look."

Ten minutes later he banged down the hood and faced his companion dejectedly.

"It's got me," he confessed. "I've been over her from stem to stern and I can't find what's wrong. The wiring seems O. K. and so are the breaker points."

"Oh, it's probably a little water in the gas," said John carelessly. "What's the difference so long as it runs? Let's get going and it may clear itself up."

But things got worse instead of better. Every mile or so, something seemed to happen inside the motor that made it lose more and more power. Even gradual hills began to prove too much for high gear.

Finally, as Fred shifted into low to coax the car over a slight grade just outside of town, the motor drew its final gasp and refused to start again.

"I knew it was coming," Fred wailed. "Now what are we going to do?"

"Call the Model Garage, of course," said John. "You stay here and I'll find a phone."

A short time later, Gus Wilson, veteran mechanic and half owner of the Model Garage, arrived in his service car.

The two men related the peculiar happenings of the last hour.

"Now let me get this straight," Gus said when they had finished. "First of all, when you started out, everything seemed to be O. K. Then all of a sudden you noticed that the motor didn't have its usual pep. It got worse and worse until she wouldn't climb hills and finally stopped altogether. Is that right?"

STEFFINS nodded. "And the motor sounded all right," he added.

"Good. Then we can start from there." Gus walked to the rear of the car, unscrewed the gas tank cap, and peered down the hole. "Plenty of gas. It can't be that," he reported.

"And the gas line isn't clogged either," put in Crae. "We checked up on that."

"Well, gas isn't our problem, then," agreed Gus. "Have you got the motor crank handy?"

"How about the ignition?" Steffins asked as he handed Gus the crank. "Do you want it on?"

Gus shook his head and began turning the motor over slowly by hand. "That's funny," he said finally. "The compression's not so good. Does the motor use much oil?"

"Don't put in a quart from one oil change to the next," said Steffins. "She's not a heavy oil pumper if that's what you mean. Take a look at the plugs. You'll see they're pretty clean."

"Well, something's cut down the compression. But then, I never knew a motor to go dead just because the compression was a little weak," said Gus.

LIKE a doctor examining a patient, the veteran mechanic went over the motor piece by piece. The ignition, wiring, distributor, carburetor, breaker points, condenser, and the spark plugs all proved to be in perfect order. To Steffins and Crae, finding what had caused the motor suddenly to lose power and stop seemed like an endless trail of tests.

"One more thing and we'll have the answer," announced Gus at last. "I want somebody to hold his foot on the starter button while I put my ear next to the carburetor."

Steffins lost no time climbing into the driver's seat. When Gus signalled, he stepped on the starter. As the motor spun, a hissing noise, like escaping air, came from the carburetor.

"There! Did you hear that?" cried Gus, turning to Crae.

Crae nodded and moved closer to the motor block. "Plain as day," he agreed. "You know, come to think of it, I heard that this morning but didn't pay any attention to it. What does it mean?"

"That's the deciding symptom," Gus chuckled triumphantly. "When a motor suddenly loses power and stops and the carburetor makes that hissing noise it can mean only one thing—"

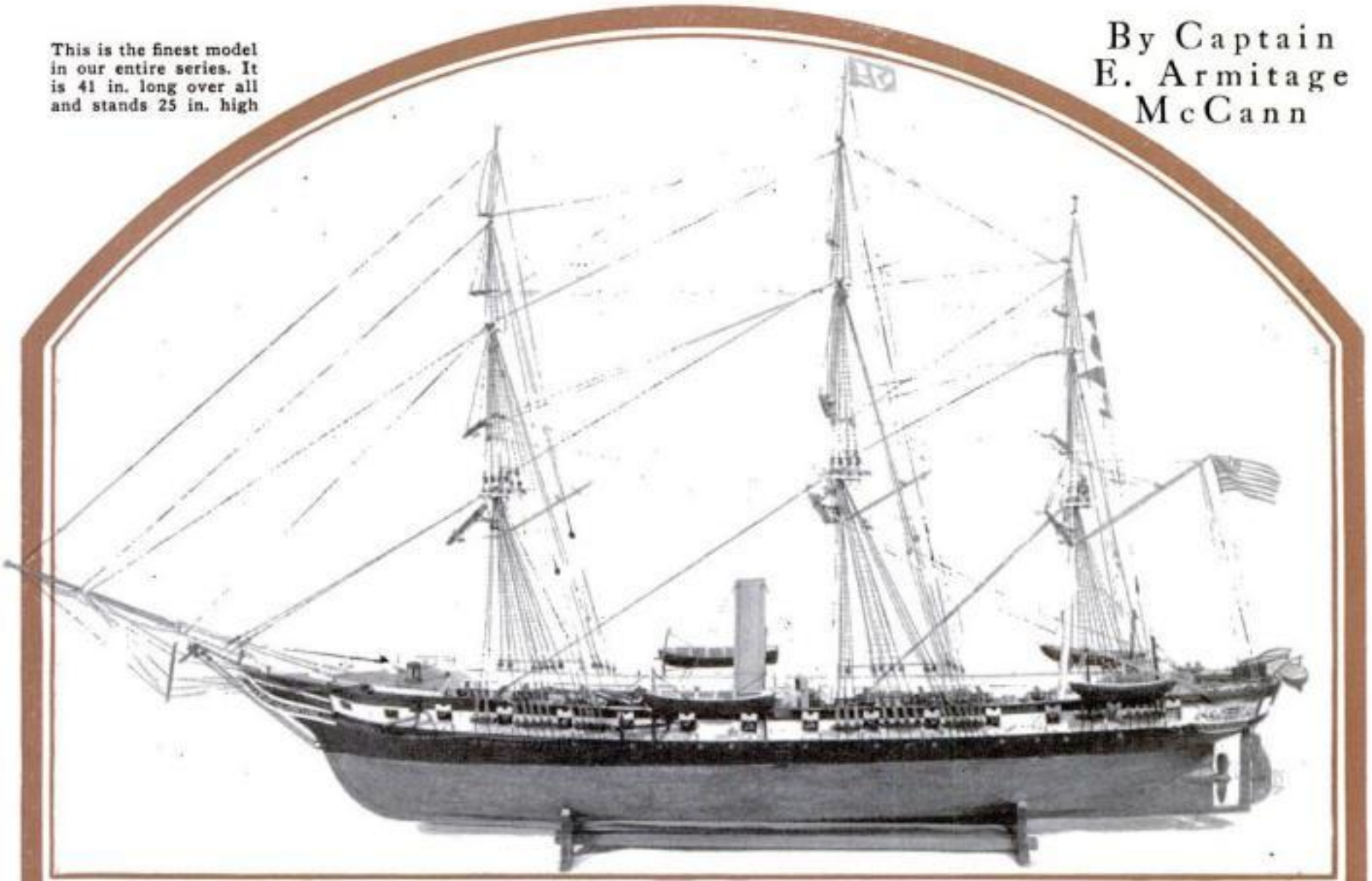
What ailed Steffin's car? Put on your thinking cap and get in line for a prize. POPULAR SCIENCE MONTHLY is going to pay twenty-five dollars ($25) for the best letter from a reader describing the trouble and telling how to remedy it.

Was the fault in the battery? The valves? The pistons? Or was it something else? Get busy right away and mail your entry to Gus Wilson, POPULAR SCIENCE MONTHLY, 381 Fourth Avenue, New York, N. Y. before January 31, 1934, when the contest closes.

Of course, all employees of POPULAR SCIENCE MONTHLY and their families are excluded from this contest and in the case of a tie, each tying contestant will be awarded the full prize.

This is the finest model in our entire series. It is 41 in. long over all and stands 25 in. high

By Captain E. Armitage McCann



The model you've been waiting for...

FARRAGUT'S FLAGSHIP *HARTFORD*

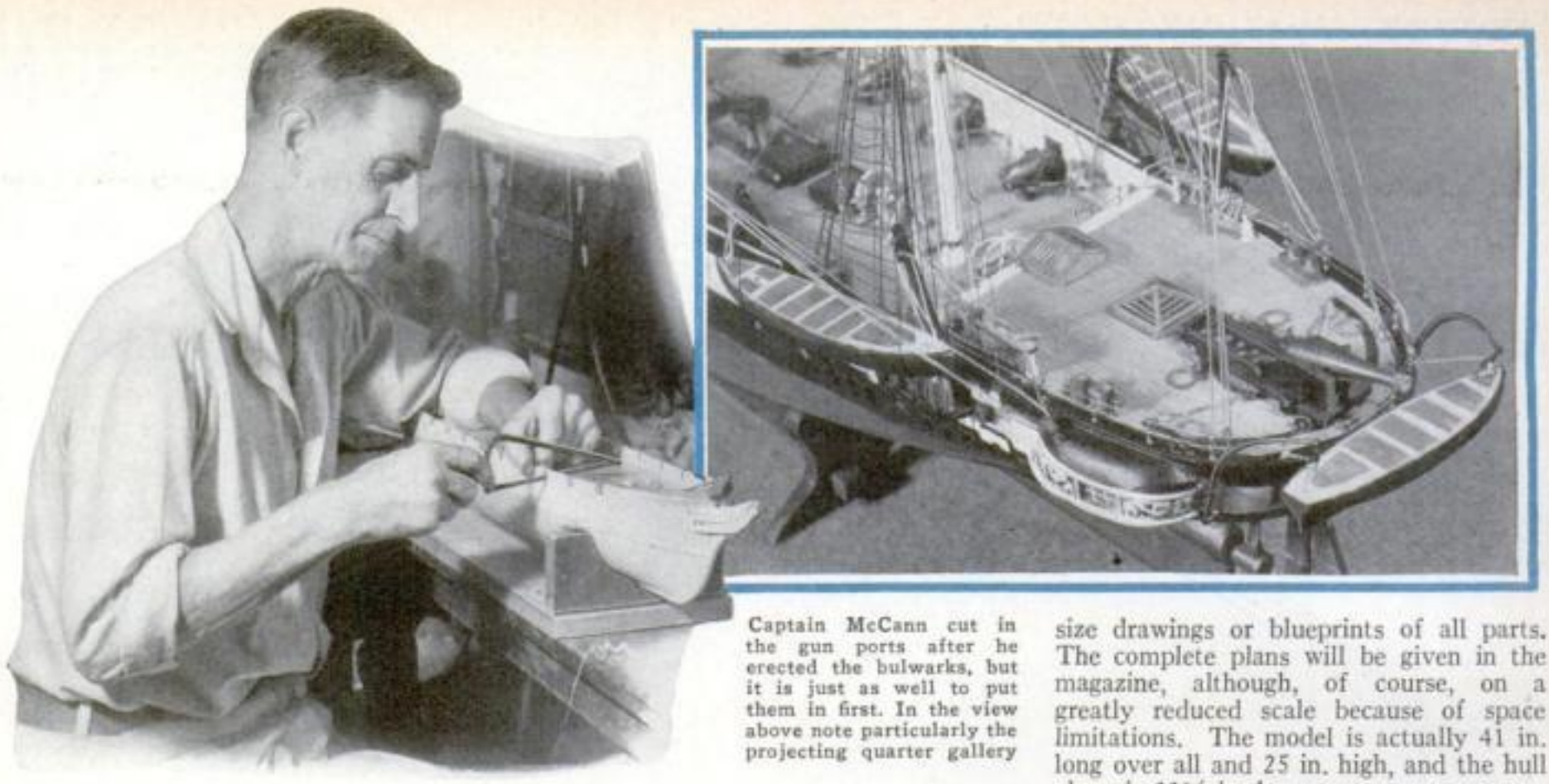
Most Famous of Steam-and-Sail Warships

FOR years readers have been requesting a model of the United States sloop-of-war *Hartford*. With the exception of "Old Ironsides," she is the best known of our battleships. She was Admiral David G. Farragut's flagship during the Civil War and was victorious in several hard-fought actions against Confederate ships and forts. Since then she has served on home and foreign stations and as a training ship, and is now at Charleston, S. C., as a station ship. Her place in naval history is secure.

Equally important from the ship model maker's point of view is that she is a famous example of a distinct type. The *Hartford* belongs to that short period in history when steam served as an auxiliary to sail. This model therefore helps to round out the series of ship models we have been describing in POPULAR SCIENCE MONTHLY.

The *Hartford* was launched in 1858 and commissioned the following year. Since then she has undergone many alterations. An extra deck and navigation bridge were added, and at one time she had two funnels. Our endeavor, however, is to make her as she was at the height of her fame when she fought under Admiral Farragut during the Civil War.

Built at a cost of $502,650.16, she had 2,700 tons displacement and 1,900 tons burden. Her length is 225 ft. between perpendiculars (marked *PP* on the plans) and 310 ft. over all; her beam 44 ft., her



Captain McCann cut in the gun ports after he erected the bulwarks, but it is just as well to put them in first. In the view above note particularly the projecting quarter gallery

depth 35 ft. She was at the outset a full-rigged ship and was classed, when built, as a second-rate screw sloop. Her hull is constructed of wood.

She was originally fitted with a direct-acting, two-cylinder jet condensing engine of 34-in. stroke, driving a single two-bladed propeller. Her maximum speed under steam alone was 9.5 knots.

At first she had sixteen 9-in. shell guns, but during the Civil War this was increased to twenty, twenty-two, and twenty-four, with two rifled swivel guns and two light howitzers. Her normal war-service crew was thirty-four officers and 280 men.

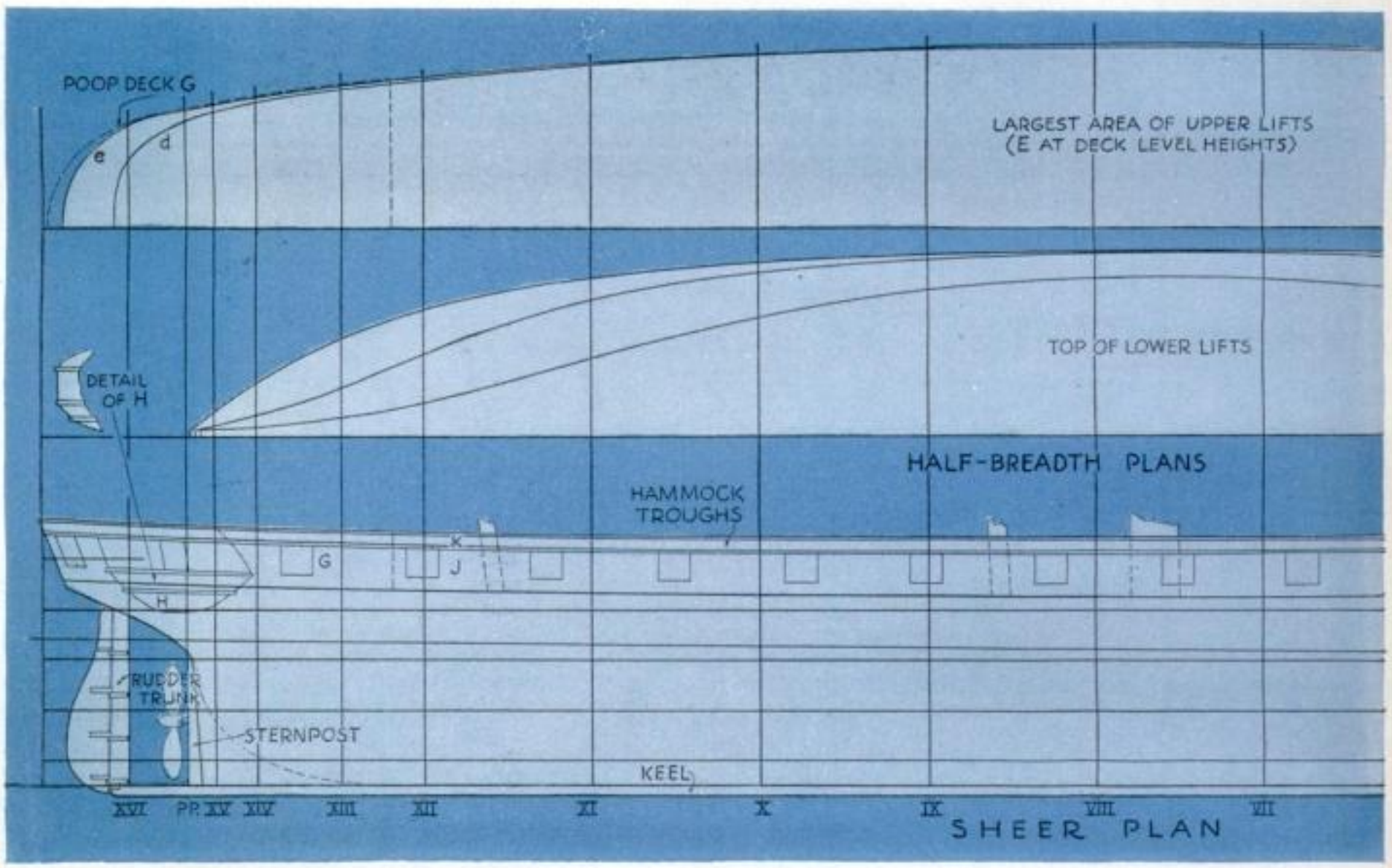
Those who have made other models in this series will be pleased with this one. She has been more carefully worked out in detail than any model we have yet attempted. She has all the important features of steam, sail, and battleship. The result, if carefully done, is a remarkably beautiful model of genuine historic interest and great value.

Although she requires a lot of careful work, there are no difficulties the beginner cannot overcome if the instructions are followed step by step.

Now to get to work. The scale adopted is that of ⅛ in. equals 1 ft. of the real ship. It is first necessary to have full-size drawings or blueprints of all parts. The complete plans will be given in the magazine, although, of course, on a greatly reduced scale because of space limitations. The model is actually 41 in. long over all and 25 in. high, and the hull alone is 33½ in. long.

To make the hull, get four pieces of clear, straight-grained white pine, 5¾ by 31 in. and dressed to ¾ in. thick. On each, from the half-breadth plan, mark the center line and construction lines I to XVI; then from the same plans mark the lines *b*, *c*, *d*, *e*—one on each piece. On another piece of pine only ⅜ in. thick mark the line *a*. Saw out each one to these lines, leaving plenty of stock beyond the lines for shaving and sanding. Bring the construction lines and the center lines over the edges with the aid of a try-square.

Note that the *a*, *b*, *c* lines are water-lines; that is, their top dimensions are



This is a ship to please every model maker. She is a beautiful sailing ship and at the same time a steamship and a warship

given, but for pieces *D* and *E* the greatest width is given, because they are wider amidships at the bottom than the top. This can be seen on the body plan and is due to the tumble home. It is the width at the deck level that is given for *E*. If you cut to the lines shown, you should be able to work out your hull correctly.

To lighten the model and make it less likely to warp, pieces *B*, *C*, *D* can each have their centers jig-sawed out to within about 5/16 in. of the outline of the piece below. If this is done, it is well to leave a solid piece in each approximately amidships to act as a crossbar and prevent the pieces spreading when the pressure of the clamps is applied.

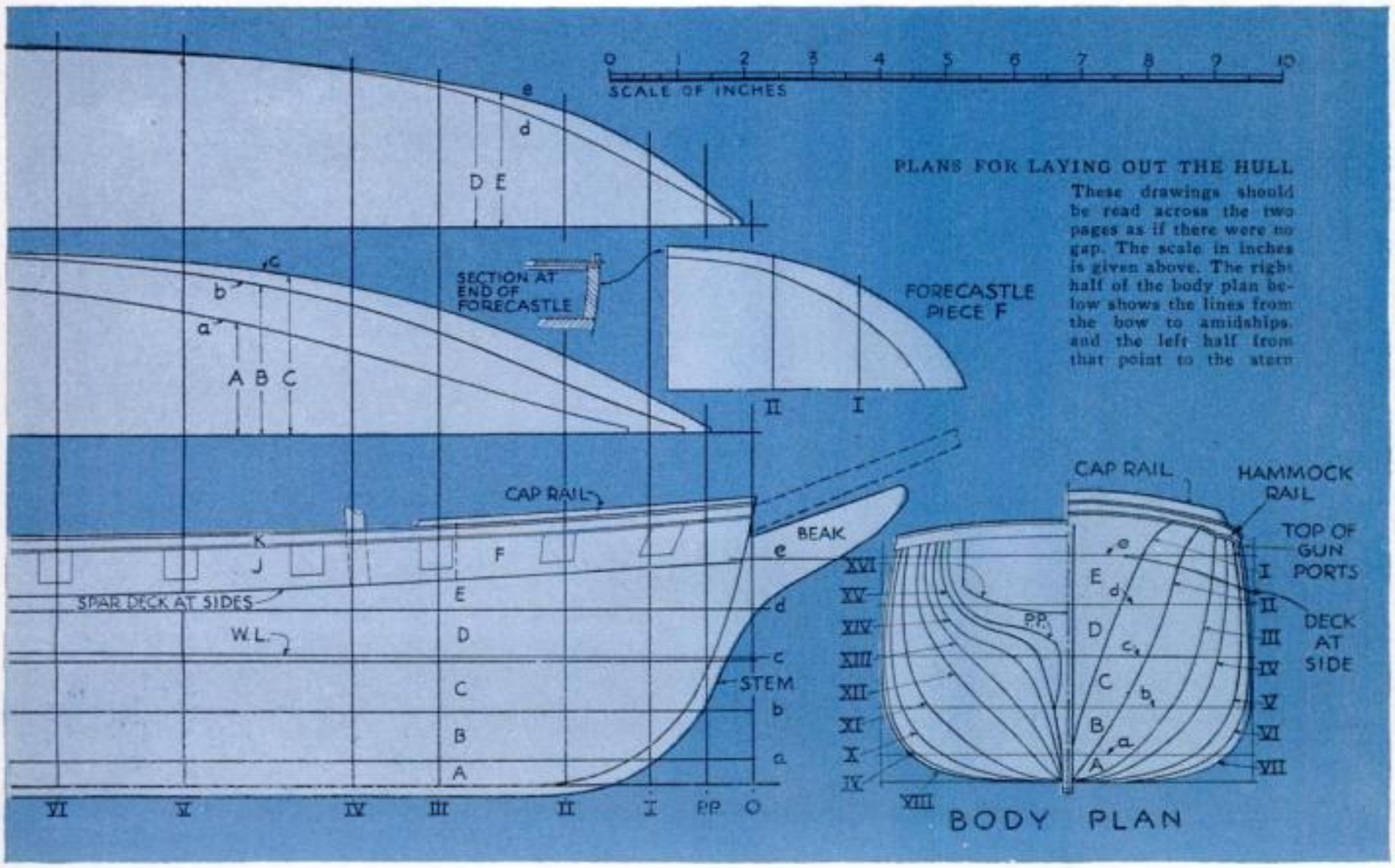
Now glue these pieces together, being careful that the center lines at the ends and the side construction lines coincide exactly.

The next job is to make a set of templates from the body-plan lines. They can be stiff cardboard or tin. Also make templates from the sheer plan for the lines of the bow and stern. On all templates mark the height of line *c*. From the bow and stern templates, cut the block to the shape of the stem and stern and remark the center lines.

Screw a block of wood to the top of the hull, where the screw holes will not show (such as at the hatch positions), or use any other means you prefer to grip the hull securely in a vise, and shave down the sides until the templates fit at their respective positions when at a right angle to the center line and with mark *c* at the junction between *C* and *D*. Work right along from amidships, bringing the whole down smoothly without hills or hollows. The dotted line at the stern shows where the planking joins the deadwood; from here aft the sides are flat and of the same thickness as the sternpost. I find it best to make my templates vertical from their greatest width (about the water line amidships) and to shave to that, then later mark the deck outline and shave off the tumble home from the greatest width.

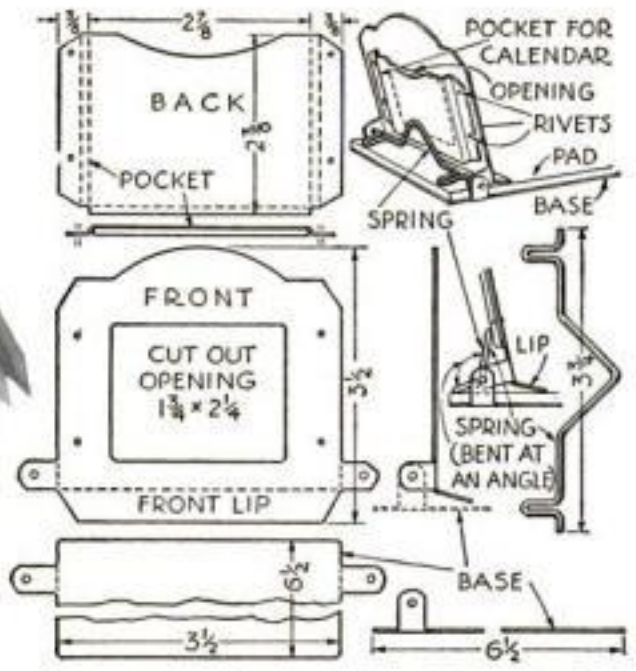
Shave down the top of the block to the deck level, marking it with dividers up from line *d*. The line of the deck at the sides is given, but amidships the center of the deck will be 1/8 in. higher because of the camber; and at the ends, of course, it will be the same height as at the sides, with a smooth curve between. It is easiest, however, to leave this deck quite flat across, where the poop piece is to go on.

The poop *G* may well be a solid piece. It is 3/8 in. thick and is glued and nailed right onto the *(Continued on page 86)*



KEEPING PAD AND CALENDAR TOGETHER

The pad rests on a hammered copper base. To remove or replace it, the calendar pocket is pressed backward against the bent wire



To MAKE the combination memo pad and calendar illustrated above, first lay out and cut the base from 18-gage soft sheet copper. It is 3½ by 6½ in. with two lugs or extensions ⅜ in. wide and ½ in. long. The total width of the blank must therefore be 4½ in. Hammer one side, drill holes in the lugs, and bend up. The face is cut from a piece of the same material 3½ by 4½ in. The side lugs are each ⅜ by ½ in., so the finished width is actually 3½ in. The front lip is ½ in. wide, Cut out the center opening with a chisel or a jeweler's saw. Hammer, drill holes, and bend to shape.

For the pocket 24-gage copper is used. This is not hammered. The spring is made from 6½-in. length of 3/32-in. hard copper wire.

All riveting is done with brass escutcheon pins. The calendar is attached to the base with the spring, which also acts as a grip for a memo pad. Spring the two ends through the lugs on the face, then pass them on through the lugs on the base. The V in the center should rest against the back of calendar.

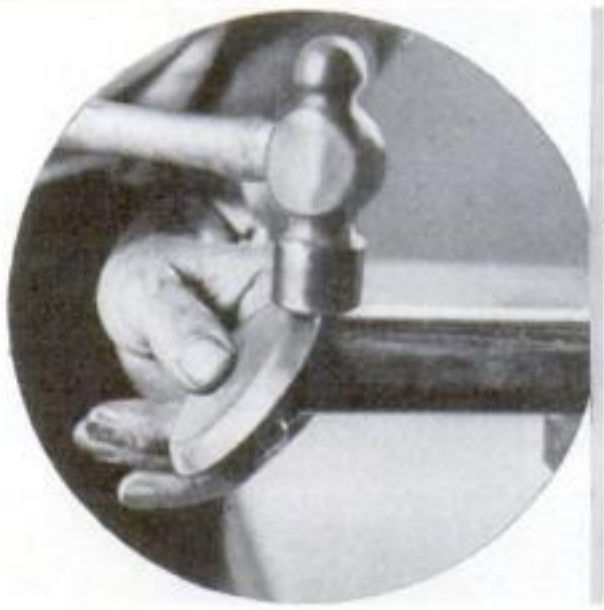
Dissolve a small piece of liver of sulphur in a quart of water. After washing the pieces thoroughly, immerse them in this until they take on a brown color; then wash, dry, polish, and protect the surface with lacquer.—R. J. HUGHES.

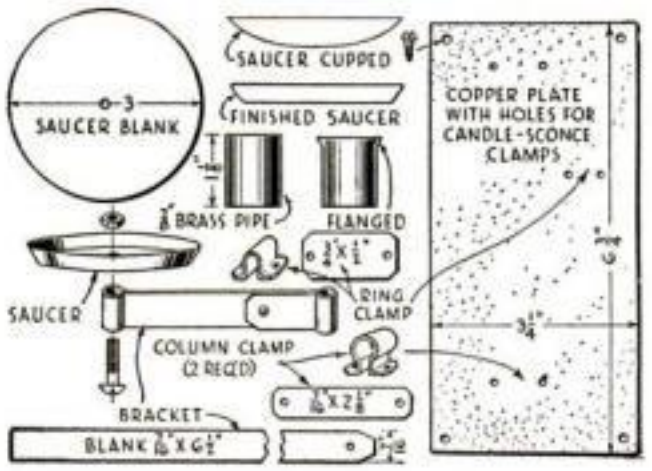
MODERNISTIC HOLDER FOR A CANDLE

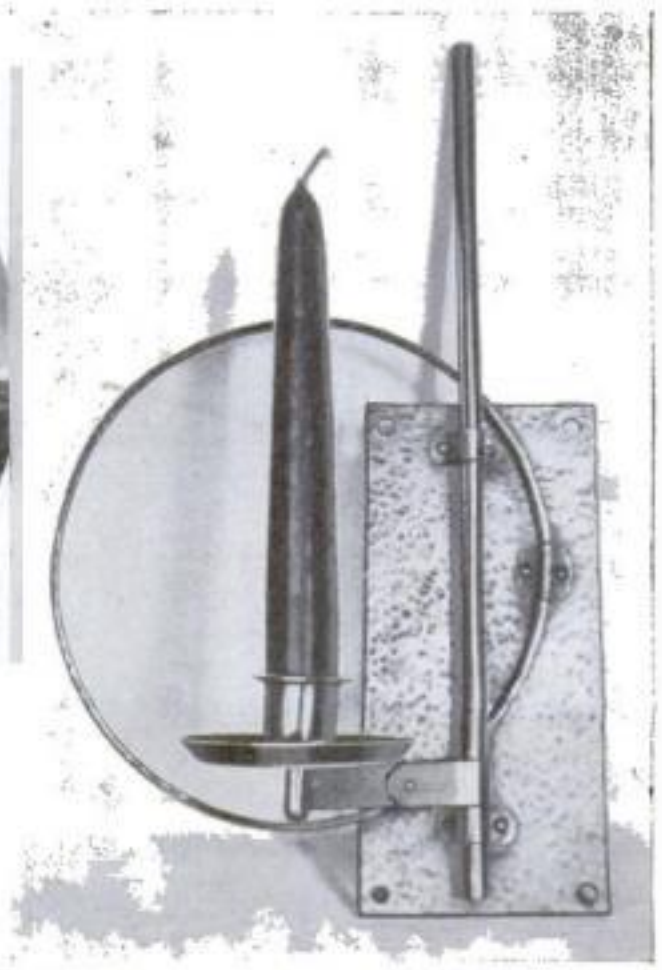
BECAUSE if its unusual modern design, this adjustable candle holder should appeal to amateur metal workers. The ring is a 22-in. length of 3/16-in. copper wire, which is hammered flat and soldered or riveted at the joint. The plate is made of 16-gage sheet copper. It is given a hammered finish, and holes are drilled as shown. The clamps are also of 16-gage copper.

The column is 5/16-in. outside diameter brass tubing 12 in. long. The bracket is of 18-gage sheet brass, shaped as shown. The saucer also is of 18-gage brass. It is cupped by hammering on the inside and expanding to a depth of about ⅜ in. Then place a round hardwood stick in the vise and shape the saucer over this. Drill a ¼-in. hole through the center.

The candle cup is made from a 1⅛-in. length of ⅞-in. brass tubing with one end flanged. Solder the cup into the saucer, then attach the completed cup and saucer to the bracket with a ¼-in. round-headed brass machine screw. Slip the bracket onto the brass column and assemble the entire candle holder. Polish the piece all over and lacquer.—DICK HUTCHINSON.

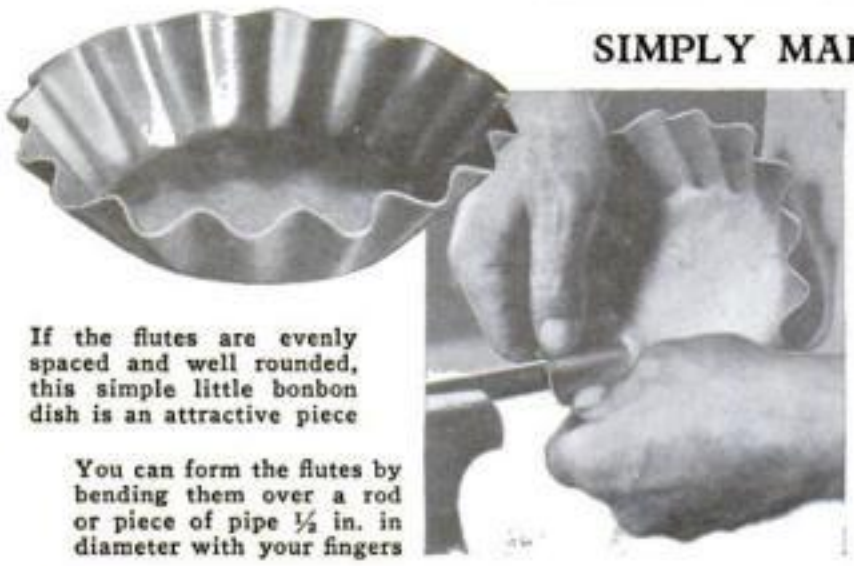






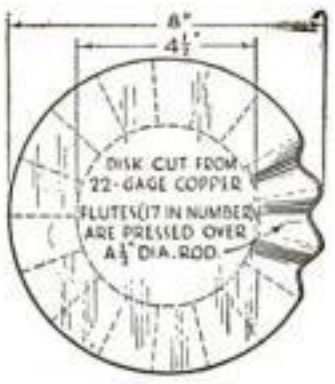
The striking arrangement of straight and circular lines and the contrast between brass and copper make this candle holder especially appropriate to use in any room furnished in modern style. The saucer is hammered over a round hardwood stick held in the vise as in the circle

SIMPLY MADE COPPER BONBON DISH HAS FLUTED RIM



If the flutes are evenly spaced and well rounded, this simple little bonbon dish is an attractive piece

You can form the flutes by bending them over a rod or piece of pipe ½ in. in diameter with your fingers



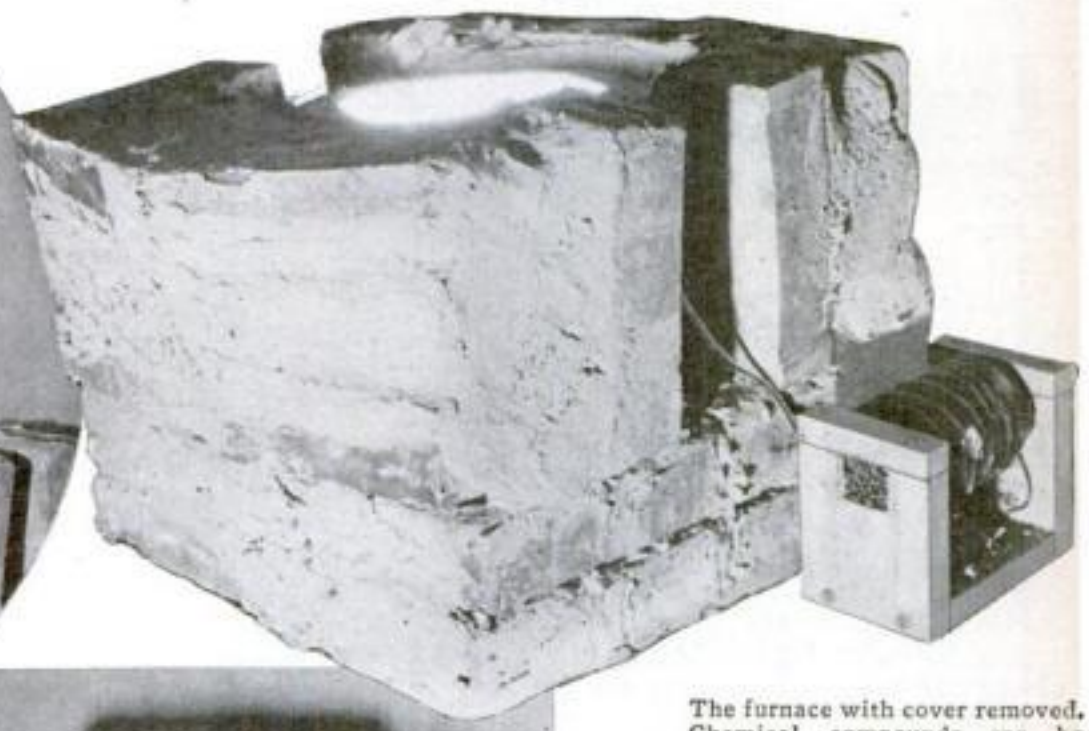
The blank with two of the flutes bent. The spacing is done by eye

THIS fluted copper bonbon dish is one of the simplest pieces that can be made by hand, and yet is useful and attractive. Cut a disk 8 in. in diameter from a sheet of shiny new 22-gage soft sheet copper, and draw a 4½-in. circle in the center. The flutes are formed by placing a rod or piece of pipe ½ in. in diameter in the vise and pressing the edge of the disk down over it. Bend in to the line of the 4½-in. circle, as shown. Try to get the flutes as evenly spaced as possible. working from both sides. When completed, polish all over. Lacquering should be omitted.—J. C. WHITCOMB.

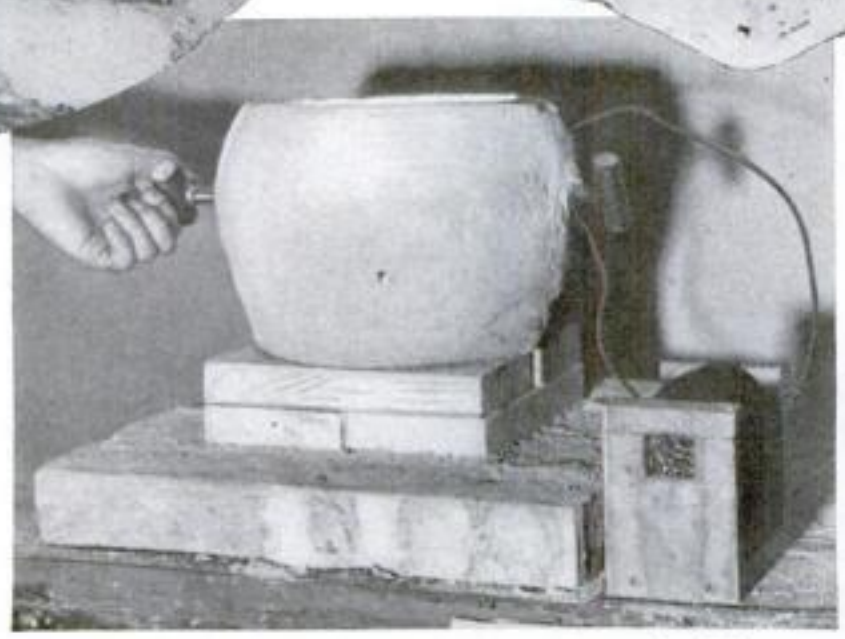
Small Portable Arc Furnace

Easily Built of Clay and Bricks

Use rubber gloves to avoid electric shocks and don't look at the arc itself unless you wear dark goggles



The furnace with cover removed. Chemical compounds can be prepared in small crucibles set on the bottom within the bowl



How the bowl is set up on bricks. A wood base should be provided so that the furnace can be carried easily by two persons

By

ROBERT B. BISHOP

HOME workshop experimenters are often stumped for the lack of a high-temperature furnace. It is relatively easy, however, to build a furnace like the one illustrated, which develops about 2,300 deg. F. and satisfies all ordinary needs.

Preparing Clay Mixture. In a crock mix smoothly 5 lb. of kaolin, 20 lb. of fire clay, 25 lb. of silica (white sand), and enough water to make a plastic mixture. Remove about 15 lb. and pound it on a board until all air is forced out. Repeat with remainder. Allow to set over night, keeping it covered with a damp cloth.

Carbon Connections. Thread a 12-in. length of ¼-in. pipe, cut it in two, then drill and tap holes for set screws as shown. Fit wood handles on opposite ends and wrap with friction tape.

Construction of Bowl. Make a disk of clay 10½-in. in diameter and 3 in. thick. Form a strip 2 in. wide and 3 in. high. Place this on the base, all along the edge, and smooth with moistened hands. Lay the pipes and nuts on this wall directly across from one another and 4⅞ in. from the bottom surface of the base. Complete construction of the walls until 8 in. high. Construct the lid according to the drawings. Set all in a cool place for four days, then remove outdoors for a similar period.

Baking Clay. After they have been air-dried, place the leather-hard bowl and cover in a cool oven. Start with a temperature of 50 deg. F. Every hour and a half raise the heat 50 deg. until a temperature of 450 deg. is reached. Then reduce the heat 100 deg. every hour and allow the clay to cool slowly. When cool, drill the specified air holes.

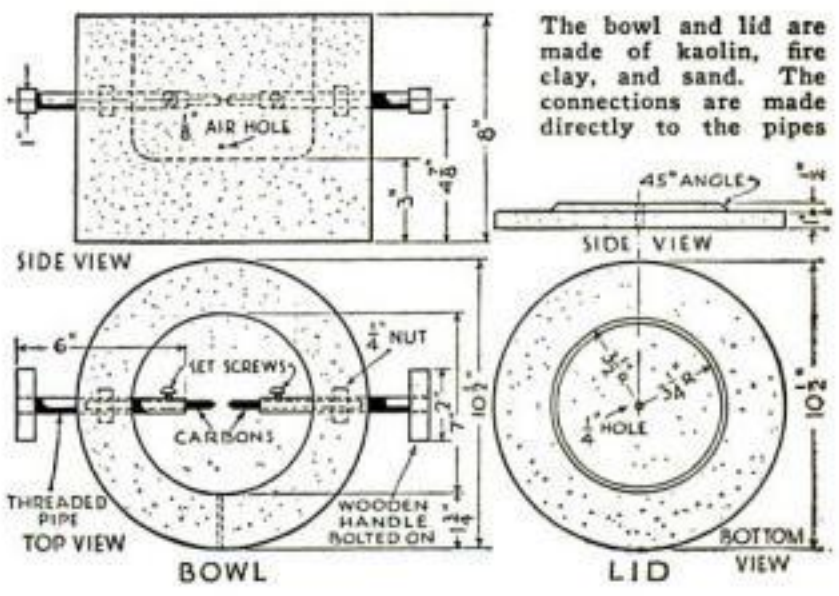
Laying Brick. Lay common brick on sheet metal and fill in between them with clay. Prepare more clay, using same ratio as before. Set the bowl on the fire brick slices. Construct a brick wall around the fire brick and bowl as shown. Pack between the bowl and brick with powdered asbestos mixed with water. Allow to dry thoroughly.

Reactance and Connections. All electric arc furnaces need a reactance. A simple one may be constructed by winding 210 ft. (1½ lb.) of bell wire around 220 strips of annealed iron wire. (For more information in regard to making a reactance see P. S. M., May '33, p. 80.)

List of Materials

10 lb. kaolin or china clay (80c.)
100 lb. silica or white sand ($2)
100 lb. fire clay No. 1, pyrometric cone equivalent rating 30 (78c.)
4 fire brick slices (25c.)
40 common brick (50c.)
6 lb. powdered asbestos (30c.)
12-in. length of ¼-in. pipe and 2 nuts for ¼-in. pipe (50c.)
2 carbons, ¼ in. (30c.)
18 by 18 in. 10-gage metal (50c.)
6 alundum crucibles, 1-in. mouth ($1.20)
210 ft. (1½ lb.) bell wire (75c.)
150 ft. annealed iron wire, No. 14 (25c.)
1 by 5 in. board, 5 ft. long (15c.)

NOTE: The prices in parentheses are what the author paid. The fire clay and fire brick slices may be obtained from any oil-burner establishment.



The bowl and lid are made of kaolin, fire clay, and sand. The connections are made directly to the pipes

JIG-SAWED STARS FORM COLORFUL

Christmas Candle Holders

By John C. Workley

THE jig saw and the candle joined hands to produce these colorful Christmas novelties. The modernistic, tree-shaped candelabra and the various star-shaped candle holders may either be set on a mantel or used to dress up the Christmas dinner table, but wherever placed they will add a gay and unique note to the Yuletide decorations.

Stars or similar forms are the foundation for all the designs. They can be cut from wood ranging in thickness from ¼ to 1 in., or from sheet aluminum or other metal. A band saw or a handsaw can be used instead of a jig saw in most cases.

One of the easiest ways to lay out a five-pointed star is to draw a circle and divide it into five equal parts, using a protractor or the trial-and-error method. Then draw straight lines connecting every other division point.

The modernistic candle-tree consists of three star-shaped pieces mounted on a base and spaced by uprights of square or round cross section. Near each point of the two large stars, and in the center of the small one, are candles, eleven in all.

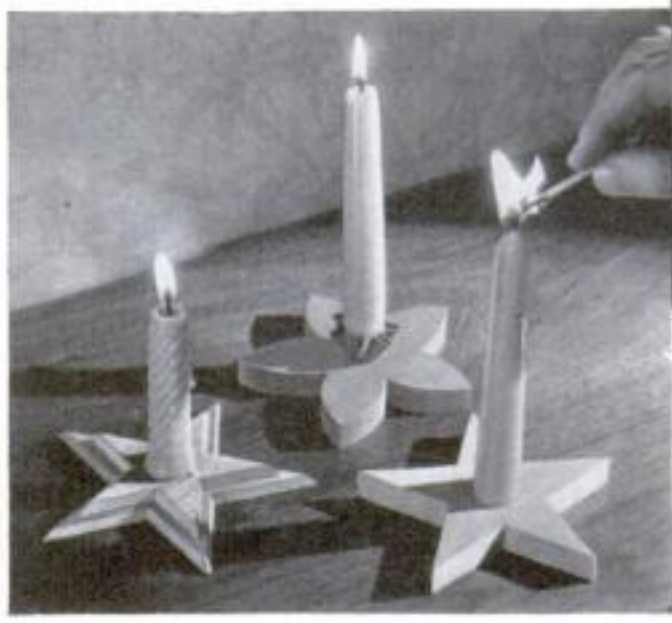
Assembling the base of a tree-shaped candle holder like that shown at the right of this page. Solid wood can be used if you prefer

The parts of the large candle-tree are doweled. To draw a star, divide the circle into five equal parts and join every other point with straight lines

The base is 4 in. square and 3½ in. high. You can cut it from a solid block of wood, build it up by gluing 3½ by 4 in. blocks together until their combined thickness is 4 in., or make it from five pieces of wood whose joined edges are cut on a 45-deg. miter. The latter method is illustrated. In this case the surfaces of the sidepieces were grooved to increase their attractiveness, but this is not necessary.

The lower star is cut from a circle 12½ in. in diameter; the middle one from a circle measuring 8¾ in., and the upper one from a 4-in. circle. The material should not be much more than ½ in. thick.

The upright between the base and lower star is about 1⅛ in. square and 1½ in. long. The one between the lower and middle star is 1 in. square and 3½ in. long. The remaining upright is about ¾ in. square and approximately 4½ in. long.



A holder for eleven candles made in the shape of a modernistic Christmas tree. *At left:* Three individual candle holders

The candles should be 6 or 7 in. long when new. A simple and effective way of mounting them is to drive slender nails through the two larger stars, from the underside, about 1½ in. from each point, so that the nails project upwards for about 1 in. To prevent splitting, it is wise to drill holes slightly smaller than the nails. A nail with its head removed is driven into the center of the topmost star to support the upper candle.

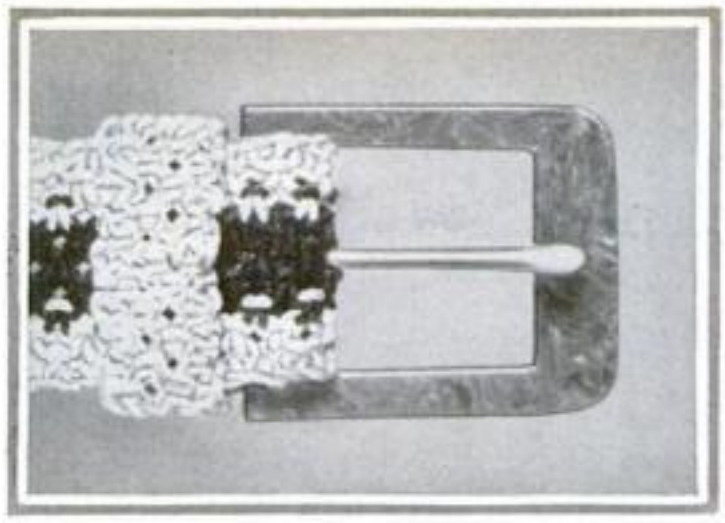
The parts are held together by ½-in. wood dowels glued in place. Bore ½-in. holes through the centers of the stars and into the ends of the upright pieces for a distance of about 1 in., and also in the center of the base. Before assembling, lacquer the stars a brilliant green and the base and uprights red. Arrange the stars so that the candles of one will project upward between the points of the next one, as illustrated.

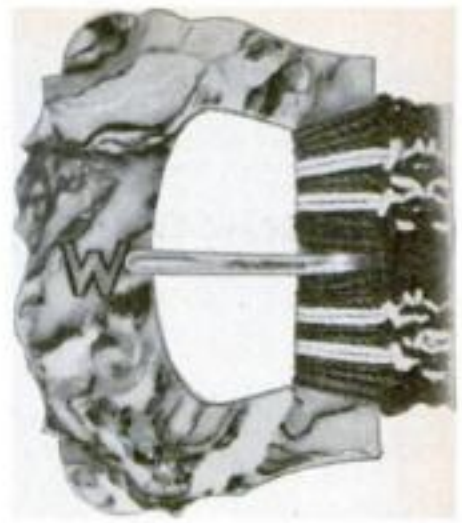
The simplest candle holder is a star sawed from ¾-in. wood and lacquered some brilliant color or color combination. The candle can be held by a nail, set in a hole bored in the center of the star, or inserted into a little cup formed from sheet copper or lead. Incidentally, if you use nails for holders, you will find that the candles slip into place easier if the nails have been heated with a small torch or candle flame.

Another form of candlestick consists of two or three stars of progressively smaller sizes, mounted one on the other, and each painted a different color. Fancy woods can be combined and finished to show their natural grains. For variation, you can cut the star edges on an angle. In doing this, you will find the jig saw almost indispensable. Tilt the table and use a slender blade that will enable you to turn corners easily. For straight cuts with a level table, a wide blade is better because it has less tendency to wander.

If you find that you will have too many stars scattered about, you can add variety by making candle holders or modernistic trees in some other form. As a suggestion, a candle base that has five points shaped like the petals of a flower is illustrated. A wood poinsettia with bright red petals and a yellow candle in the center would be particularly appropriate.

Four completed buckles. The third is built up of two thicknesses with a steel rod set in between





Homemade Celluloid Buckles

LEND ADDED BEAUTY TO KNOT-WORK BELTS

REALLY useful gifts are the kind most appreciated when Christmas rolls around, and few suggestions could be more appropriate than to give attractive cord belts with handmade buckles designed particularly for those who are to wear them. Such individual buckle-and-belt sets have an expensive look, but, luckily, the main cost is in the time required for making them. The materials themselves cost but little.

How to make the belts has been told in previous articles of this series (P. S. M., Nov. '32, p. 77, May '33, p. 63, and Sept. '33, p. 65). The present article will give suggestions for preparing suitable buckles.

Heavy sheet celluloid is the material used, and it is surprisingly easy to work with. Six plain colors are available, as well as tortoise, jade, mottled biege, and onyx. Celluloid that is about 1/10 in. thick is best. Squares of 2 or 3 in. are required for each buckle. The scraps may be saved for inlay work in other materials. Material of this thickness and in the different colors can be obtained from stores and mail-order dealers specializing in handicraft materials. It should be remembered that celluloid is inflammable, but small pieces of the type described afford negligible danger, being slow burning and easily extinguished.

First draw the design (several sample designs are illustrated) or trace one on thin paper placed over catalog pictures, if you happen to have a catalog showing craftworkers' buckles. Cement the drawing or tracing to the celluloid squares with rubber cement. After drilling small holes for the blade, you are ready for sawing.

The material cuts very easily. A fine blade should be used in the

(Continued on page 75)

1 The designs are drawn or traced on paper and rubber-cemented to the celluloid stock

2 It often improves the appearance of a buckle if the saw table is tilted about 15 degrees

3 Cutting an initial with a tool made by sharpening the point of a nail V-shaped

4 The notch for the tongue of the buckle is cut into the celluloid with the edge of a file; and files and sandpaper are used to smooth the edges of the buckle and remove all irregularities left by the saw

5 If the glossy finish is marred by scratches or accidental file marks, it can be restored by flowing acetone over the celluloid as at left

6 The tongues are made from 12- or 14-gage annealed brass wire bent as shown, then hammered to harden them

7 After the tongue has been slipped in place on the buckle, the bent end may be closed with a nail set

A *Money-Saving Christmas Hint*

By KENNETH MURRAY

A wood-finishing demonstration before the club at Rockford, Ill., which holds Charter No. 1 in the National Homeworkshop Guild

What the NATIONAL HOMEWORKSHOP GUILD *will do for you*

WHAT is the National Homeworkshop Guild?"

"How can I become affiliated with it?"

"What will the Guild do for me?"

These are the three questions I am asked most frequently. I shall try to answer them as definitely as possible in this article for the benefit of all who make a hobby of their home workshops. Since POPULAR SCIENCE MONTHLY has consented to act as the official magazine of the Guild, I feel sure that its readers will be keenly interested in knowing what the Guild movement stands for and what it will do for the amateur craftsmen of the United States. If there is anything further you wish to know after finishing this article, please write me personally at the national headquarters of the Guild, 312 Harper Avenue, Rockford, Ill.

To begin with, the National Homeworkshop Guild, Inc., is a noncommercial corporation chartered in the State of Illinois to promote and encourage the formation of clubs for the advancement of all classes of what may be called "homecraft"—all types of home workshop activities and all branches of amateur craftsmanship. In announcing the formation of the Guild last month, POPULAR SCIENCE MONTHLY put it very clearly when it said the Guild is to be a great mutual benefit association for those who follow any type of handicraft hobby.

If you read the Home Workshop Department of this magazine regularly, that fact alone is sufficient indication that you should be affiliated with the Guild. But how can you become affiliated? That is very simply accomplished. You must be a member of a local home workshop club having not less than five members. The local club then obtains a charter as an affiliate in the National Homeworkshop Guild, Inc., and immediately is entitled to all the benefits and services of the Guild. A little later on I shall tell what these benefits and services are, but first let me explain about forming a local club.

The officers of the National Guild have had considerable experience in this work because they organized the original club in Rockford which has been so successful. A typical meeting of this club is illustrated above. We know how a club should be run. All this information is at your disposal in a complete bulletin that has been prepared on the subject of forming a local home workshop club. You can have this free at once simply by sending a large self-addressed, stamped envelope and the coupon given on page 87.

The bulletin explains how to obtain

By LeVern T. Ryder

President, The National Homeworkshop Guild, Inc.

names of prospective members, where to hold meetings, how to call the first meeting and conduct it, how to apply for affiliation with the National Homeworkshop Guild, how to choose a name, how to prepare your local constitution and by-laws, how to arrange for adequate publicity, and what to avoid. I cannot go into all this in the limited space available here, but I can assure you that you will have no difficulty in organizing a local club if you follow the suggestions given in the bulletin.

Let me now outline briefly the more important things that the National Homeworkshop Guild will do for each local club affiliated with it.

First and perhaps most important, it will provide all the information necessary to make your club successful—information such as that contained in the bulletin just mentioned. Once a month the Guild will send the secretary of each affiliated club a bulletin or news letter. Some of these will contain detailed and carefully studied plans for conducting one or more meetings; others will contain information on exhibitions, contests, and all topics of interest to local clubs.

Second, the Guild will conduct a speakers' bureau. Much information has already been assembled as to where speakers and demonstrators may be obtained by the local clubs. The club in Rockford always has some informative address or demonstration as a main feature of each meeting, and its experience in building up such programs will be placed at your disposal. Various large manufacturers have promised their utmost support to the Guild and are willing, when a sufficient number of clubs have joined the organization, to provide expert instructors and demonstrators who will go from club to club. This service will be developed as the organization grows, but meanwhile the Guild will be able to show you just how to develop interesting programs and find good speakers in your own locality.

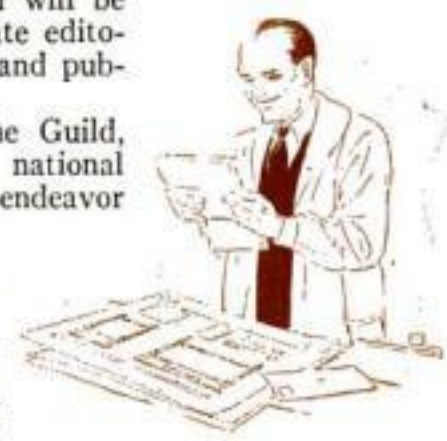
In the third place, the Guild will provide information on club projects and community projects. Nothing will add more to a club's popularity, for example, than to make a number of toys for poor children or orphans, and this can be done very easily and inexpensively by dividing the work up among the members. The resulting publicity is likely to bring in new members and will enhance the prestige of the club in the community.

The Guild, as a fourth service, will help you find just what type of work you can do most successfully and with the greatest pleasure and profit. In recent years the home workshop has grown to be an institution of extraordinary diversity. The divisions, the possible projects in each branch, and the machines, tools, equipment, and materials are almost beyond cataloging. The Guild will show you the whole field so that you can pick out the specialties you like best.

Fifth, the efforts of the Guild and affiliated clubs will be given unity and made immeasurably more effective by having Popular Science Monthly as a national organ. All the important news of the organization will be published in this magazine. Not only will the formation of each local club and the names of its officers be reported, but all the activities of the Guild will be given adequate editorial support and publicity.

Members learn rapidly through demonstrations and discussions

Finally, the Guild, through its national officers, will endeavor to answer the questions that arise in connection with all local club activities. As the organization grows, an information bureau and reference library will be built up that will be invaluable to the amateur craftsmen of the United States.



The Guild will gladly answer whatever questions arise in organizing and directing clubs

The dues, so far as the National Homeworkshop Guild is concerned, have been fixed as low as possible. Each local club pays to the Guild 50 cents per member per year for the sole purpose of promoting the work of the Guild. Perhaps the greatest thing about the Guild is the fact that it is entirely noncommercial. It has nothing whatever to sell. Its officers and directors are giving their services free. They have defrayed out of their own pockets all the costs of organization. Furthermore, they have the advice and support of an advisory council of men of national distinction, all of whom have freely volunteered their services.

In the very same spirit, Popular Science Monthly has extended the utmost coöperation to the Guild. Its editor and home workshop editor have both *(Continued on page 87)*

Making toys for orphans and poor children is one of the finest community projects for any club to undertake

Six Great Services

Provided by the National Homeworkshop Guild

1 Bulletins, news letters, and all instructions necessary for making a local home workshop club successful.

2 A speakers' bureau for giving information as to where lecturers, instructors, and demonstrators may be obtained.

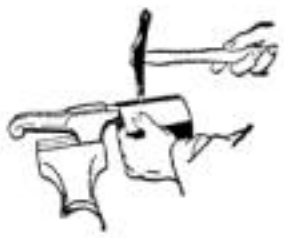
3 Plans for community projects, exhibitions, club and group projects, and handicraft contests.

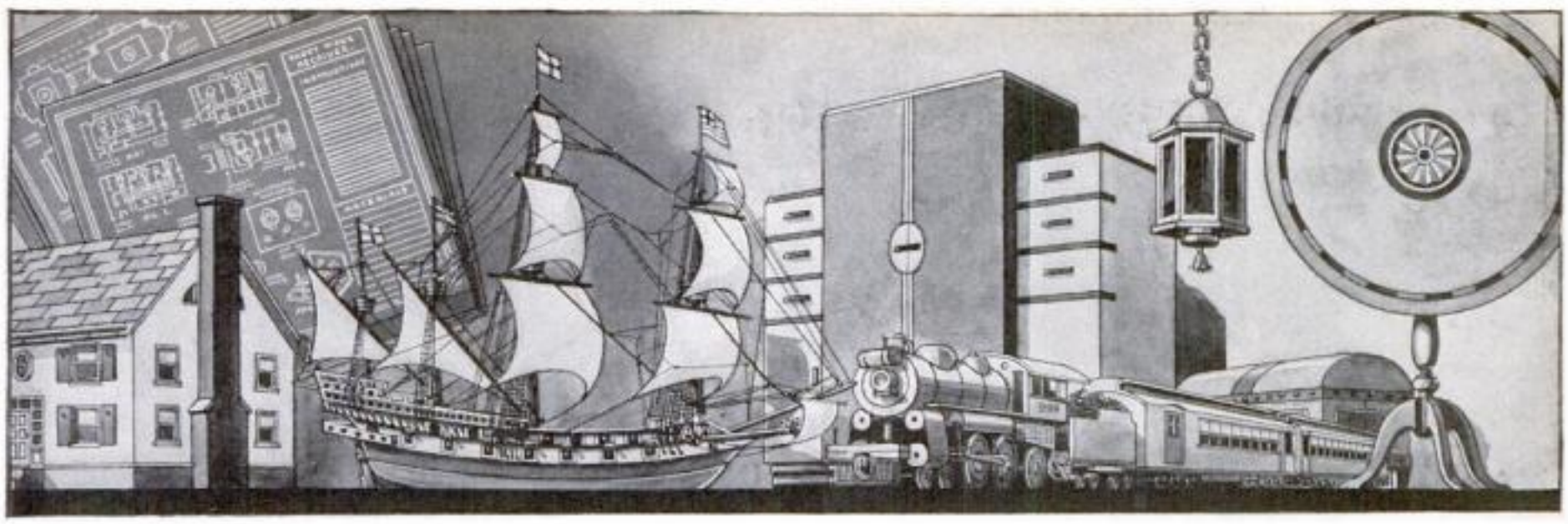
4 A survey of the whole home workshop field so that you can find your own best specialties in it.

5 The prestige and editorial support of Popular Science Monthly, which is the official magazine of the National Homeworkshop Guild.

6 An information bureau for answering questions that arise in connection with local club activities.

Good Luck National Homeworkshop Guild *We'll Do Our Part!*

IT IS our belief that the formation and  purpose of the National Homeworkshop Guild, as described elsewhere in this magazine, represents one of the most important  steps ever taken in the organization of handicraft activities over the entire country. Nor could a more opportune time have been chosen for  its inception. Now that men in every walk of life find it necessary to adjust their ways to the use of more leisure time, thousands will find in these local clubs a new and  intriguing solution to their spare-time problems. And to the hundreds of thousands already spending  countless happy hours in the pursuit of homecraft hobbies, the Guild offers added opportunities through the coöperative efforts of its associated clubs. The undersigned congratulate the  organizers and wish them every success. We invite all club members to use us as a source of information. The experience of ex-



perts employed in every experimental and research phase of  **homecraft work is always at your disposal. And to those who desire it, first reports of all new develop-ments in these companies will be**  **available. Again let us extend our best wishes and our hopes that from this modest beginning will arise a series of clubs throughout**  **the country, promoting homecraft work and spreading the message of pleasure and profit which these splendid activities bring to every man.**

•

E. C. Atkins and Company
Indianapolis, Indiana
Atkins Silver Steel Saws

The Carborundum Company
Niagara Falls, N. Y.
Sharpening Stones and Grinding Wheels

The Casein Mfg. Co. of America, Inc.
New York, N. Y.
Mfrs. of Casco Waterproof Glue

Delta Manufacturing Company
Milwaukee, Wisc.
Makers of Quality Motor-Driven Tools

•

Henry Disston & Sons, Inc.
Philadelphia, Pa.
Saws · Tools · Files · Knives · Steel

William Dixon Incorporated
Newark, N. J.
Mfrs. & Imp. of Tools for Arts & Crafts

Greenlee Tool Company
Rockford, Ill.
Bits, Chisels, Turning & Mortising Tools

The Irwin Auger Bit Company
Wilmington, Ohio
The Irwin Bluwin Bit

Millers Falls Company
Greenfield, Mass.
Millers Falls & Goodell Pratt Tools

•

Nicholson File Company
Providence, R. I.
"A File for Every Purpose"

Russia Cement Company
Gloucester, Mass.
LePage's Liquid Glue and Casein Glue

Stanley Tools
New Britain, Conn.
Hand Tools, Electric Tools

Walker-Turner Co., Inc.
Plainfield, N. J.
Mfrs. of "Driver" Power Tools

IT'S EASY TO FIT UP A

Darkroom *in Any Home*

By Frederick D. Ryder, Jr.

The cellar darkroom in which the author works. The window at the left is made lightproof by a plywood blind. The workbench and chemical storage shelves were built from the cheapest yellow pine sheathing

For any window such as in this bathroom, a blind can be made from a piece of ⅛-in. pressed-wood board edged with black velvet

ARRANGING satisfactory darkroom facilities without upsetting the rest of the family is one problem every amateur photographer has to face as soon as he gets beyond the press-the-button, let-someone-else-do-the-rest stage of the hobby.

Indeed, many amateurs of the type to whom developing, printing, and enlarging make a strong appeal are scared off by the apparent difficulties. Actually it is quite easy to fix up a good darkroom without disturbing anyone, even in a small apartment.

The first question: How dark must a darkroom be and how can it be made that way? The answer depends on what work you expect to do. If you have a roll-film camera, develop your films in a daylight-loading tank, make prints on velox or similar paper, and do not go in for bromide enlarging, any room in your home will be dark enough at night without even bothering to pull down the shades.

If, however, you develop roll films in a tray, develop film packs, cut films, or plates, or do bromide enlarging, you must have a darkroom that is absolutely free from light. A perfect darkroom, photographically speaking, is one you can sit in for fifteen minutes with all lights out and at the end of that time not be able to see a single thing—not even so much as a vague hint of light around the door or window frames.

Your first thought will be to hang blankets over the windows to cut off the light. That will do in an emergency, but is a nuisance as a regular practice. It is much better to fit light-proof blinds to the windows and fix the door so no light gets in around the edges. The details of this job depend on the windows in the room and the type of door, and they, in turn, will differ according to the room you choose or must, through force of circumstances, use for your darkroom.

If you live in a private house, obviously the best location for the darkroom is the cellar, preferably in the laundry where there is running water. In a small apartment, the bathroom is a logical choice for the same reason. On the other hand, any arrangements you make in the bathroom of a small apartment must not interfere with its normal use or make the room unsightly, otherwise there will be strenuous objections from the other members of the family.

The kitchen also is an excellent choice, especially the modern type with its large single or double drain-board sink. A point in its favor as a darkroom is that ordinarily you can have undisturbed use of it after the supper dishes are out of the way.

Bear in mind that running water is not an absolute necessity. If I were forced to choose between any reasonably large closet that I *(Continued on page 70)*

An inexpensive darkroom light with interchangeable screens

A Chance for Everyone in Our New $50 PRIZE PHOTO CONTEST

YOU have no restrictions to worry about when competing for one of the eight prizes in our new $50 contest for indoor photos. The subjects can be anything you please, and the prints may be of any size. Only the quality and the general interest of the picture itself—not its size or mounting or finish—will be considered. This gives you an even chance with every other amateur photographer, because the new lights and sensitive films now available make it comparatively easy for anyone to take good indoor photographs. You can do the developing and printing yourself, or have it done by a professional photo-finisher, as you prefer. The contest is open to any amateur photographer except employees of POPULAR SCIENCE MONTHLY and their families. You may enter as many different prints as you please. Mail them to the Photographic Department, POPULAR SCIENCE MONTHLY, 381 Fourth Avenue, New York, not later than February 1, 1934, and mark your entry "January Photo Contest." It is not necessary to send the films. No prints will be returned unless a self-addressed, stamped envelope is inclosed. In case of ties, each tying contestant will be awarded the full amount of the prize tied for.

FIRST PRIZE	$25	THIRD PRIZE	$5
SECOND PRIZE	15	FIVE PRIZES, $1 each	5

EASTMAN'S Annual Gift Guide

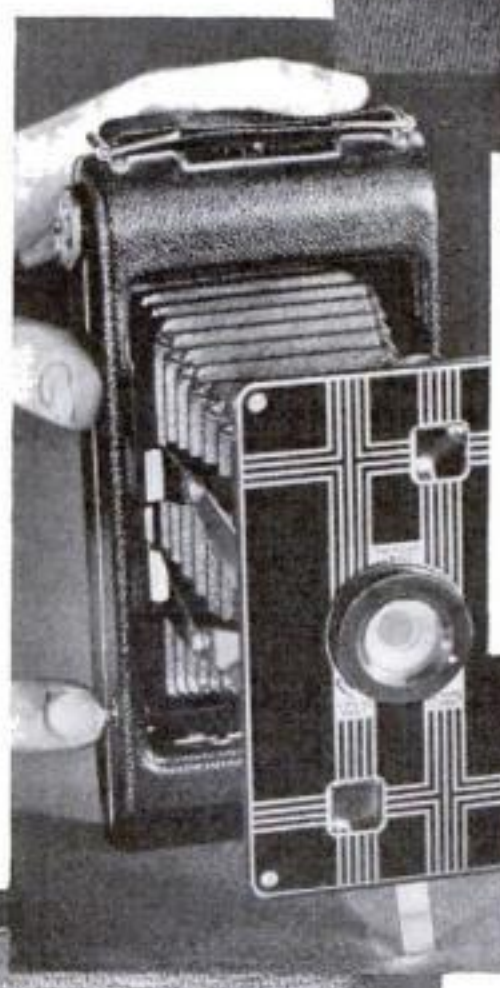
• Sharpshooters for experts . . . sure shots for beginners—there's a Kodak gift for every need. Kodaks for miniature snapshots . . . for large pictures . . . for movies . . . for "stills" . . . whatever your picture-making desires, there's a Kodak that fills the bill. See these latest cameras at your dealer's . . . make this a Kodak Christmas. Eastman Kodak Company, Rochester, New York.

KODAK SIX-16
MOST POPULAR OF CHRISTMAS KODAKS

• Comes in varied lens and shutter combinations to fit every user's need. The smallest, swankiest camera for 2½ x 4¼-inch pictures. With Kodak Anastigmat *f*.6.3 lens, $17. With other lenses, up to $30, down to $13.

A CAMERA AT $29.50 FOR MOVIES AT 10¢ A SCENE

• Ciné-Kodak Eight brings the excitement of movie-making within the means of everyone. Makes 20 to 30 scenes—news-reel length—on a film roll costing only $2.25, including finishing. Pocket size, easy to use, yet a real, full-fledged movie camera.



"POP"—IT OPENS
"CLICK"—IT SNAPS THE PICTURE

• Jiffy Kodak opens like a jack-in-the-box. No fussing, no fiddling. Simplest folding camera ever devised. Twindar focusing for sharp pictures. Handsomely finished in metals and enamels. For 2½ x 4¼ pictures, $7.50. For 2¼ x 3¼ pictures, $6.75.

ULTRA-FAST LENS . . . AN ULTRA-FAST SHUTTER— AN ULTRA-FINE CAMERA

• The tiny Kodak Pupille is a gem of a camera that fits in the palm of your hand. A gift for the camera enthusiast. Takes 16 sharp, clear pictures without reloading. Price with *f*.2 Anastigmat lens, 1/300 second, Compur shutter, range finder, two color filters and case, $75.

EASTMAN'S FINEST MOVIE CAMERA

• Ciné-Kodak "K" does everything. Makes clear, brilliant movies on dull days or bright, indoors or out. Brings distant action close with Telephoto lens. Makes gorgeous movies in full natural color. Loads with 100 feet of 16mm. film. Price from $110, case included.

BOYS AND GIRLS, AND—

• Boys and girls, and others who like to take pictures the easiest way, will get real joy from this Brownie Six-16. The well-known Brownie ease plus new refinement in looks and action. Price $3.50. Other Brownies priced as low as $1.50.

GIVE A KODAK • IF IT ISN'T AN EASTMAN, IT ISN'T A KODAK

IT'S EASY TO FIT UP A DARKROOM

(Continued from page 68)

could use exclusively as against the uncertain tenancy of a bathroom, I should unhesitatingly choose the closet. Carrying a few pails of water of an evening is but a small price to pay for no interruptions.

Cellar windows are usually small and easily fitted with light-tight blinds made of thin plywood or pressed-wood board. The exact method of fitting depends on the type of window. Looks will be of small importance in the cellar, so all you have to remember is that light cannot get around two right-angle corners that are painted flat black, even if the joints are quite loose.

The topmost illustration on page 68 shows a corner of a cellar darkroom. The window at the upper left is fitted with a plywood blind. Three dollars' worth of yellow pine sheathing—about the cheapest lumber you can buy—supplied the wood needed to build the workbench and chemical storage shelves, which are placed next to the enameled iron tub tops. This a convenient arrangement, gives you lots of room to work, and does not interfere with the normal use of the laundry tubs on wash day.

IF YOU will examine most bathroom or kitchen windows, you will find there is a flat surface on the frame all around the casement that is broken only by the projecting sill at the bottom. The second photograph on page 68 shows a blind being applied to such a window. It is made of ⅛-in. pressed-wood board with a strip of black velvet ribbon glued close to the inner edge and around the bottom edge where it rests on the sill. When held in place with a few thumb tacks or tiny swinging wooden cleats, it is absolutely light-tight.

When not in use, the blind can be left standing behind the radiator where it will not be in the way and will hardly be noticed if the inside surface is painted to match the walls. I have seen one blind of this type that was cleverly enameled and lined to match the tiling.

But little light gets through most reasonably well-fitted doors except under the bottom. There sometimes is as much as a ¼-in. space between the door and the sill or floor. Glue the edge of a thin velvet ribbon close to the bottom edge of the door to curtain off this unwanted light. With poorly fitted doors, such as a cellar door, or one that has warped badly, it may be necessary to glue a strip of ribbon all around the edge to stop light coming around the jamb. If the door is of any dark color, the ribbon can be of a matching color to make it inconspicuous.

Once you have the darkroom really dark, the next job is to install a safe darkroom light. The third illustration on page 68 shows the cheapest form of safe darkroom light. Colored glass screens of different kinds, ranging from the exceedingly dim green that is safe with panchromatic film, if used with discretion, to a bright yellow that gives lots of absolutely safe light for velox or similar papers, are obtainable for this light and are easily slipped into place as indicated. You can buy these safe-light screens separately in this smallest size or in larger sizes, if you prefer to make your own light-tight box for them.

REMEMBER that only the makers of the films, plates, or paper you use really know just what kind of light and how much of it their products will stand without fogging. If you try to fix up a darkroom light with untested material such as red, green, or orange electric light bulbs, you will either have too much of the wrong kind of light and fog your films or have a much dimmer light than would be permissible if of exactly the right color for the work you are doing.

The next problem is where to put the trays. This is simple in the cellar darkroom illustrated because there is plenty of working space. In a kitchen darkroom, the drain board of the sink does for the developer, short-stop, and fixing trays, and the sink itself serves for a wash box if you knock the bottom out of a small tomato can and place it over the drain so that the water has to rise to the top of the can before flowing out.

The modern bathroom washbasin rarely offers a safe support for one tray, let alone three. One solution, if the arrangement of the room makes it convenient, is to cut a wide board long enough so that it can be supported lengthwise or crosswise on the tub. The latter, when filled with water, makes an acceptable wash tank.

If the room is planned so this is not convenient, it may be possible to make a detachable shelf that will fit on top of the toilet flush box after the porcelain cover has been lifted off. This works well if the flush box is beside the washbasin and at the right height.

In the closet type darkroom where there is no running water, the most difficult problem is to get your hands clear of hypo before you put them back in the developer. The answer is to carry in two pails nearly full of water. Always rinse your hands first in one and then in the other in the same order, then dry on a towel. This double rinsing will remove so much of the hypo that what's left on your fingers won't do any damage.

THE final washing, too, can be conveniently done in a darkroom without running water. Adequately complete washing of any photographic film, plate, or paper is obtained if the water in the tray is changed at least six times at five-minute intervals. One empty pail into which to pour the discarded water and one full one from which to obtain the fresh fillings of the tray will therefore do the trick. This method of washing saves quite a lot of water, which is a matter of importance if the water rate is high in your locality.

The last and perhaps the most important of all darkroom problems is the matter of cleanliness. Photographic developing and printing are delicate chemical processes. Uniform and satisfactory results cannot be obtained with dirty trays and careless handling that allows any chemical to get where it does not belong. Dish washing is not considered a recreation whether it is practiced in the kitchen or the darkroom. Nevertheless you should make it an invariable rule to rinse out every tray thoroughly and to mop up every drop of spilled solution before you quit for the night.

This is the thirty-first article in the photographic series by Mr. Ryder. He has covered practically all the more essential information necessary for successful amateur photography, but additional articles are being planned and the series will be continued as long as readers are interested. If there is any particular topic you wish Mr. Ryder to discuss, please drop a line either to him personally or to the Home Workshop Department.

A HINT ON LAYING VENEERS

A GREAT aid to successful veneering is to use cellophane between the caul and the veneer instead of paper. Unless left for some time, the cellophane will not stick to the glue, thus saving much work.—J. H. BEEBEE.

It's EASY *to snap*
CHRISTMAS PICTURES

with this
MAGIC
NEW LAMP

15¢
LIST

What fun! Picture the children tearing open their gifts... Grandma under the mistletoe... scores of joyful Christmas scenes *indoors*. It's EASY... with the new G-E MAZDA Photoflash lamp.

Just flash the lamp and the picture is yours. No noise, smoke or dust. It's as easy as taking snapshots in sunlight.

Get some of these magic new lamps from your druggist or camera dealer and enjoy new fun this Christmas. They're only 15c. General Electric Co., Nela Park, Cleveland, O.

GENERAL ELECTRIC
MAZDA PHOTOFLASH LAMPS

Two Remarkable New Kits

Racing yacht made from KIT K

The historic *Hartford*—KIT L

THIS month you have your choice of two new construction kits that are in many ways the most unusual we have ever offered. One, marked *K* in the following list, contains ready-to-assemble materials for what is believed to be the lightest, fastest 20-in. model racing sloop ever designed. It is made mainly of jute fiber or tag board. In the kit are more than eighty separate items. The lines are those of the 12-square-meter international racing sloop *Sharpie*, and the new method of tag-board construction was devised by Louis P. Hall, Jr.

The second kit, marked *L*, contains all the raw materials (except paints) for building our new ship model, Farragut's flagship *Hartford*. The model is 41 in. long over all and 25 in. high, and is the finest in our entire series.

Following is a complete list of our kits, all of which are accompanied by instructions or blueprints:

A. Whaling ship model *Wanderer*. All the raw materials—wood, wire, fishing line, chain, celluloid, and everything but the paints, together with Blueprints Nos. 151 to 154 and booklet. The hull is 20½ in. long $6.90

AA. Same with hull lifts sawed .. 7.40

D. Spanish galleon ship model, 24 in. long. All the raw materials (except paints), Blueprints Nos. 46 and 47, and a booklet 6.45

DD. Same with the two main hull blocks shaped 6.95

E. Battleship model, U.S.S. *Texas*, 3 ft. long. All the raw materials (except paints) and Blueprints Nos. 197 to 200..... 6.95

EE. Same with hull lifts sawed.... 7.45

F. Liner *Manhattan*. All raw materials (except paints) for a simplified miniature model 12 in. long, and Blueprint No. 204. 1.00

G. Elizabethan galleon *Revenge*. All raw materials (except paints) for a model 25 in. long, and Blueprints Nos. 206 to 209.. 6.75

GG. Same with hull blocks shaped. 7.25

H. Cruiser U.S.S. *Indianapolis*. All raw materials (with enamels) for a simplified 12-in. model, and Blueprint No. 216.. 1.50

J. Clipper ship *Sea Witch*. All raw materials (except paints) for a simplified 13-in. model, with blueprint..... 1.50

K. Jute fiber (tag board) scale model of *Sharpie* racing sloop with 20-in. hull. Can be used as decoration or sailed. Very light and fast. No tools required 2.00

L. Farragut's flagship *Hartford*, a steam-and-sail sloop-of-war. All raw materials (except paints) and special Blueprints Nos. 221 and 222. The hull is 33½ in. long, and the over-all length is 41 in. 7.95

LL. Same with hull lifts sawed ... 8.45

No. 2. Solid mahogany tray-top table 23 in high with a 15 in. diameter top. Ready to assemble, but without finishes..... 5.40

No. 4. Solid mahogany book trough 22½ in. long, 9½ in. wide, and 24¾ in. high over all. Ready to assemble, with finishes.. 5.30

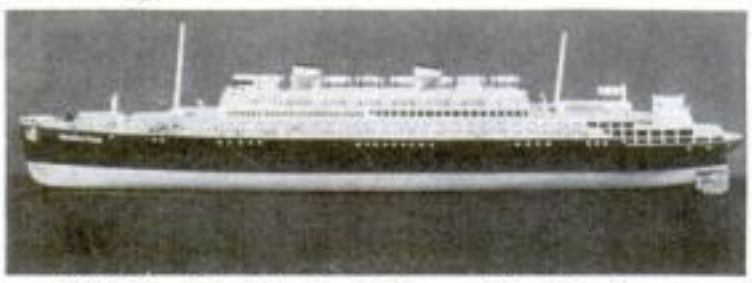
No. 5. Solid rock maple hanging wall rack with one drawer, 19½ in. wide, 33¼ in. high. Ready to assemble and stain included 5.75

No. 6. Solid rock maple butterfly table, top 19 by 22 in., height 22½ in. Ready to assemble and stain included..... 6.90

NO. 6

KIT H

KIT J—Materials for a miniature clipper ship



KIT F—Materials for 12-in. model of *Manhattan*

NO. 5

KIT G

KIT D

NO. 2

KIT A

KIT E

NO. 4

Popular Science Homecraft Guild,
381 Fourth Avenue, New York, N. Y.

Please send me Kit.....for which I inclose $..... (or send C. O. D. ☐)

Name .....

Address .....

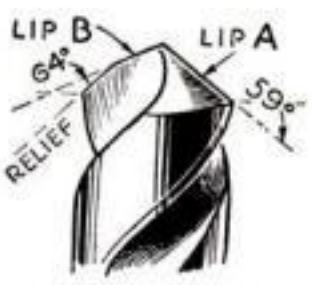
City..... State.....

(Please print name very clearly.)

Note: Prices of all kits except *F*, *H*, *J*, *K* are 50 cents higher west of the Mississippi River because of heavy shipping charges. We prepay the postage on both cash orders and C. O. D. orders, but if you order C. O. D. you will have to pay on delivery the extra charges made by the Post Office, which amount to 28 cents. Kits *F*, *H*, *J*, and *K* cannot be sent C. O. D. This offer is made only in the United States.

GRINDING DRILL POINTS FOR DEEP HOLES

A large manufacturing plant experienced considerable drill breakage with unusually deep holes in castings, especially those sizes under 5/8 in. It was finally discovered that grinding the points as shown increased the production from 60 to 75 percent. Lip *B* cuts first, the chip being half the width of the lip and nearer the center of the hole. Lip *A* also cuts the chip for half of the width, but the farther half from the center of the hole. The chip is thus divided by the two lips, and a free-cutting action results. This naturally allows a considerably increased feed.—HECTOR J. CHAMBERLAND.



Drill ground to give free-cutting action

NOW READY

. . Your copy of the 1933 Home Workshop INDEX

HOW often have you hunted through your back copies of Popular Science Monthly to find some home workshop article you distinctly remembered seeing? And what a job it was! No one ever realizes what a wealth of material is published in this magazine until he has to go through a number of issues to find some particular item.

You can save yourself all this trouble by using the Home Workshop Annual Index. This lists alphabetically every article published on craftwork, shop methods, house repairs and short cuts, model making, radio, automobiles, and such hobbies as chemistry, microscopy, and astronomy. It is a complete and carefully cross-indexed key to the most up-to-date reference material on these subjects that can be found anywhere.

Your copy of the 1933 Index is now ready and will be sent for ten cents to cover the cost of printing and mailing. A few copies of the 1932 Index are also still available.

Popular Science Monthly
381 Fourth Avenue, New York, N. Y.

Please send me the Home Workshop Index or Indexes checked below, for which I inclose ten cents each

☐ 1933 ☐ 1932

Name .....

Street .....

City..... State.....

NOTE: Please print name and address very clearly

HICKORY PLACE CARDS AT WOODCRAFT DINNER

AT A BANQUET I recently attended in honor of fathers of Boy Scouts, the favors were pieces of green hickory sawed and labeled as shown in the accompanying illustration. The Scouts obtained the small hickory tree trunks while on their hikes, and the local high school shop teacher sawed the sticks diagonally into sections approximately ¼ in. thick.

In using the idea, any available small tree trunks or branches other than hickory may be used. The diameter of a cross section of the wood may vary from 1 to 2 in. If a power saw is not available, the wood can be held in a vise and sawed by hand. Avoid marring the bark, which adds to the woodcraft look. Remove the saw marks with sandpaper, then coat the sections with thin shellac and letter with India ink.—GEORGE A. SMITH.

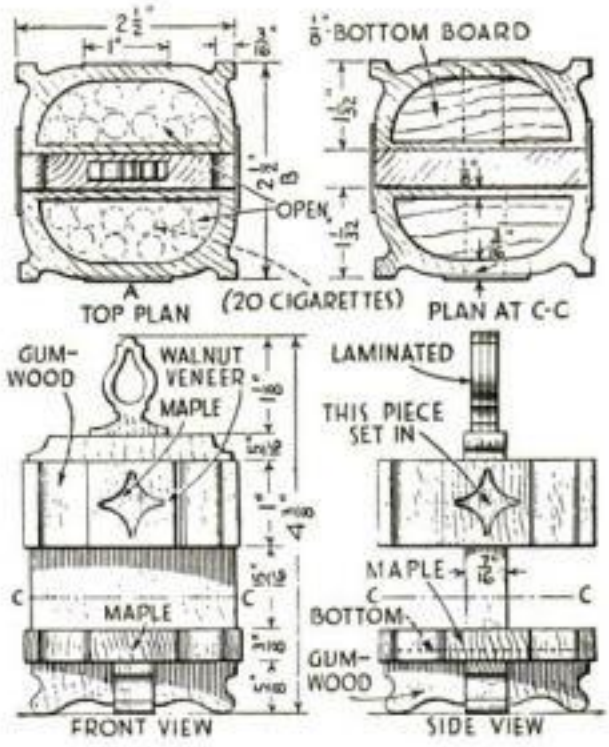
NOVEL JIG-SAWED CIGARETTE HOLDER

THOSE who wish to try something new in the way of a jig-sawed project will find this cigarette holder a novelty that is at once interesting to make and useful when completed. A number of them could be made up for Christmas presents.

The holder is made of gumwood, each half being cut out on a jig saw and glued to a solid centerpiece 7/16 in. thick, as shown in the accompanying drawings. Each section holds ten cigarettes. The toppiece, which is 1 in. high, is the same shape as the lower piece, but the latter is only ⅜ in. high. The grain of the wood is vertical in these pieces. A ⅛ in. thick bottom is glued in each half of the lower piece.

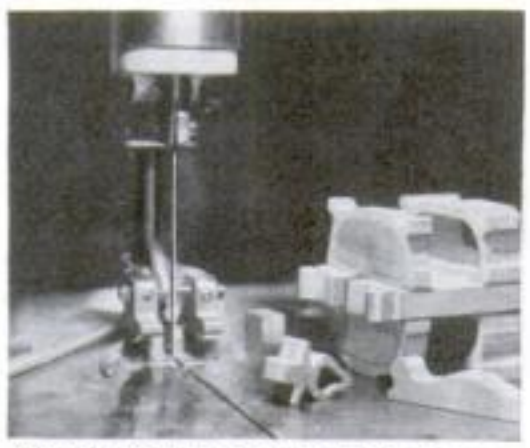
Walnut veneer with maple inserts is glued on the upper part of each side to add interest to the design and to cover the joints between the centerpiece and side sections. The same expedient is used to hide the joints in the lower part of the holder, but only maple is used here.

The handle is laminated. The centerpiece has the grain running across, and the two outside pieces have the grain running vertically.



Working drawing with principal dimensions

The holder is easy to pass around and also will keep two different brands of cigarettes separated



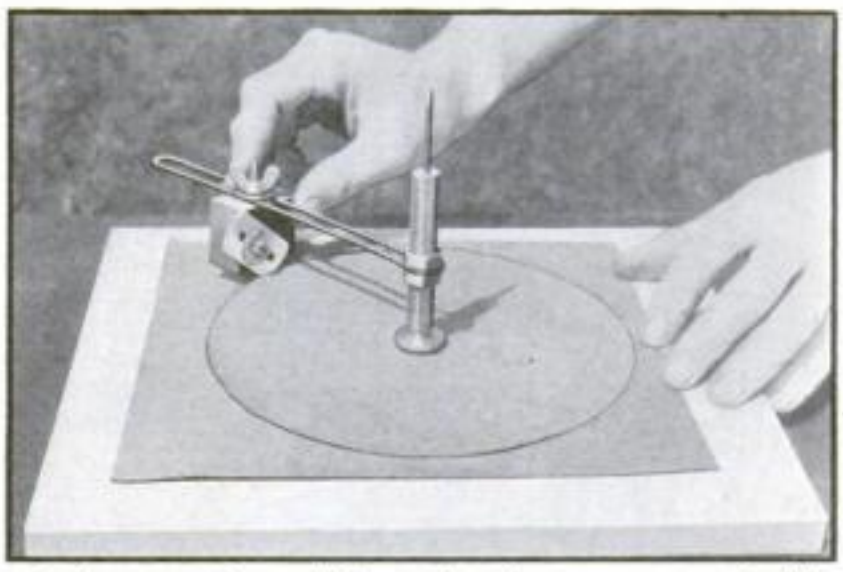
Cutting the parts for the holder is very much like making a picture puzzle

Walnut color oil stain was brushed on to darken all the wood but the maple inlays, and then two coats of thin white shellac were applied for a finish.—THOMAS B. OWENS.

Note: This design was awarded a prize in our Novelty Jig-Sawing Contest (see P.S.M., July '33, p. 63).

ROUND GASKETS CUT WITH RAZOR BLADE

ROUND gaskets of paper, cork, or felt are often needed in the garage or workshop, but are very difficult to make quickly and accurately without the use of some form of circular gasket cutter. Such a cutter can be easily made from scrap material.



A wire center pin, an old inner tube valve stem, an arm of stiff wire, and a razor blade mounted on a block form this cutter

The base is made from a piece of ⅞-in. hardwood about 12 in. square. In the center a small hole is bored, and into this is driven the center pin, which is a 6-in. length of light, stiff wire such as the ordinary wire coat hanger is made from. After it has been tightly driven in, a point is filed on the opposite end to make the center hole in the gasket material.

An old inner tube valve stem is drilled out so that it will just slip on over the center pin. Another piece of stiff wire forms the arm of the device, the middle of the wire being bent around the valve stem and securely clamped between two regular valve-stem nuts. The ends are then joined by bending them together and soldering. Space the wires so that a ¼-in. bolt will slide freely between them.

A hole is bored in a ⅞ by 1½ by 1½ in. hardwood block as shown for a 2 by ¼ in. carriage bolt. Two grooves are filed in the top of this block for the wires of the arm to slide in. The carriage bolt is fitted with a thumb nut and a plain washer for clamping the wires.

The razor blade is held by a small round-headed screw and a washer. It should be adjusted so that the cutting is done by the corner of the blade.

The gasket material to be cut is pressed on over the sharpened point of the center pin. The valve stem is next slipped on and the blade set to whatever radius is desired.—L. C. PELTIER.

BOBBINS TO AID IN KNOT WORK

The long cord ends are kept untangled

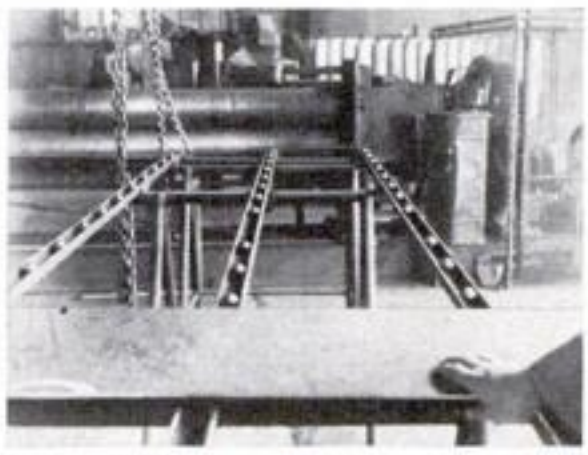
TO KEEP the long ends of cords used in fancy knot work from becoming snarled, they are ordinarily tied into hanks, but I have found it better to use small wooden holders or bobbins like that illustrated. The end of the string is passed through a hole in the bobbin and knotted. Then the reserve supply of string is wound on, and two half-hitches are taken around the longer ear of the bobbin. Since one can pull as hard as necessary against these hitches, it is more convenient to use the bobbin as an aid in pulling than to depend on one's fingers alone. When more string is needed, the line is unhitched, one or two turns are taken off, and it is again temporarily hitched on.—R. S. TALCOTT.

CHOOSING A MICROSCOPE BULB

WHEN making a microscope lamp, it is advisable to use a so-called "daylight" or blue glass bulb for illumination. This saves many a headache, and the objects viewed will reveal their true colors better and be sharper.—FRANKLIN STEINBERGER.

METAL SHEETS ROLL ON BALL-BEARING SKIDS

THE movement of large and heavy sheets of metal to and from punch press, rolls, and other machines is made much easier and faster by the use of a ball-bearing skidway like that illustrated. Two or more thick 2- or 3-in. channels have holes punched in them at regular intervals and sockets welded in for



A shop skidway set with large ball bearings on which heavy sheets of metal slide easily

steel balls. Each ball is inserted through the hole, after which a small section of plate is welded over the hole. Welded horses of pipe are used to support the channels. Short sections of larger channel stock are welded crosswise on the horses to receive the long ball-bearing channels.—JOSEPH C. COYLE.

CELLULOID BUCKLES

(Continued from page 63)

scroll saw, and the cutting done with long, light strokes. If a power saw is available, use the finest jig-saw blades and feed the material against it slowly; otherwise the heat will melt the celluloid, cause sticking, and break the blade. Sawing at a 15-deg. angle gives an attractive beveled appearance to the work. (See Fig. 2.)

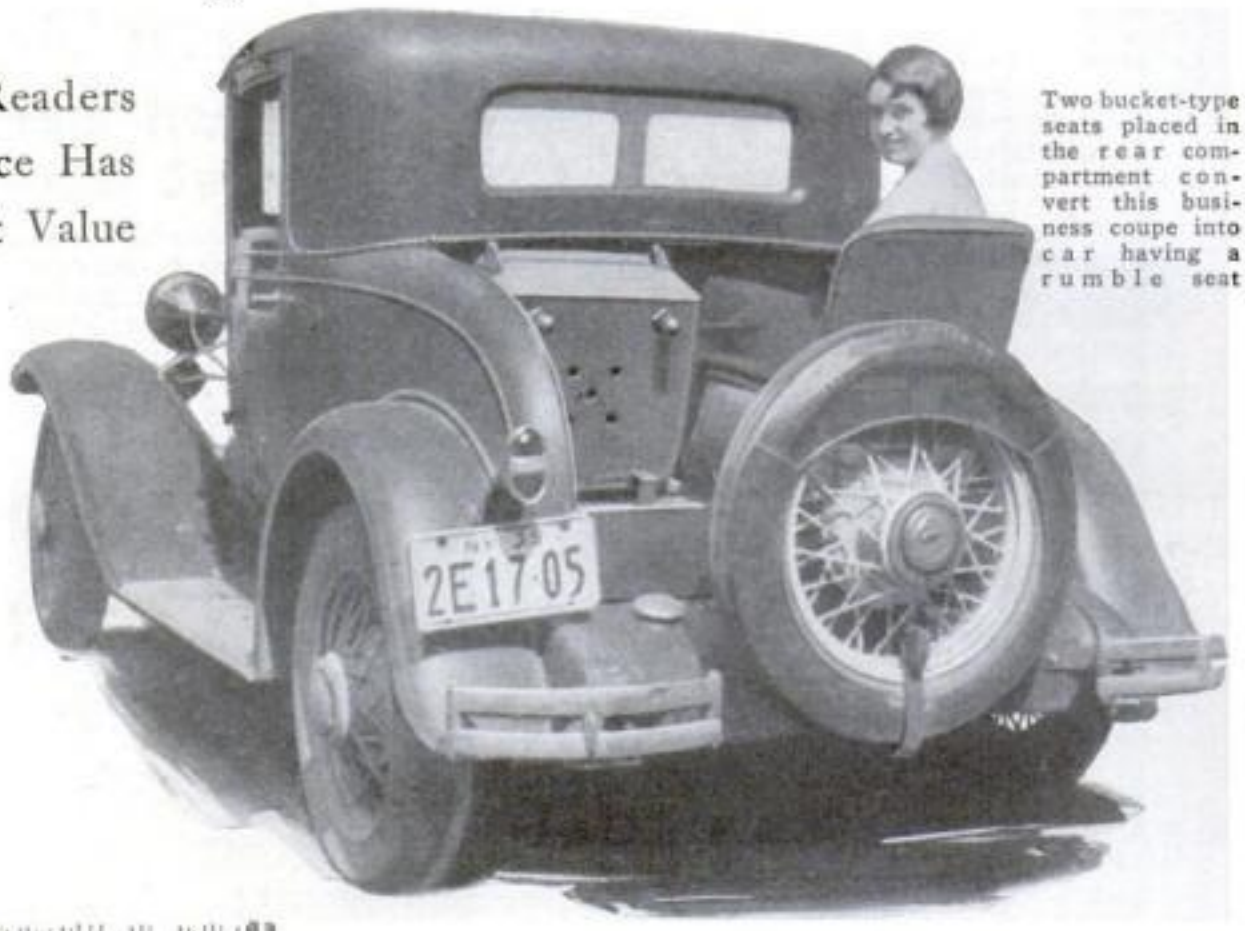
The sheet celluloid is very easily engraved with any design by using a nail. Grind and file the point V-shaped and hone it until sharp. Figure 3 shows the way to hold the graver in cutting out an initial. If desired, the lines may be filled in with prepared wax, or even thick oil paint such as artists use.

Sandpapering and filing are necessary to even up the edges of the buckles. A velvet finish may be obtained by polishing with pumice stone and water. Whenever it is necessary to restore the glossy finish, as after sanding and filing, and to remove scratches, flow acetone over the buckle with a clean brush. This must be done quickly to avoid leaving brush marks (Fig. 5). Acetone, which is a solvent, is also useful for cementing two sheets of celluloid together to build up a thick buckle. Clamp the parts together until dry, then flow the edges with acetone, which will conceal the joint and make the two parts look like one.

Tongues are made from short pieces of heavy (12- or 14-gage) annealed brass wire. This is easily bent to the required shape, after which it is pounded partly flat with a hammer to temper the metal and give it the requisite hardness. An odd way to finish the tongues is to dip them in a hot solution of 20 grains of lead acetate, 50 grains hypo (sodium hyposulphite), and 4 oz. of distilled water. As the temperature of the solution rises, the tongues will rapidly change to many colors, one at a time. They are removed when the desired color is visible. The metal will be found covered with a tough film of the color. A test tube and Bunsen burner are handy implements for this operation.

Useful Hints *for* Car Owners

Ideas Furnished by Our Readers Whose Practical Experience Has Demonstrated Their Great Value



Two bucket-type seats placed in the rear compartment convert this business coupe into car having a rumble seat

BY INSTALLING two bucket-type seats, I recently converted the rear compartment of my business coupe into an inexpensive, yet comfortable, rumble seat. An automobile junk yard that harbored a disabled coach yielded the seats for a few dollars. After the lid to the rear compartment was removed by loosening two bolts, I placed the seats to allow plenty of leg room and bolted their hinged standards to the compartment floor. When not in use, the seats can be folded down and the lid replaced. If at any time I want to remove the seats entirely, all I have to do is pull out the hinge pins in the standards.—R. G. A.

Cutting the bottom of garage doors on an angle, as shown, will keep ice from forming so they stick. Note oak sill high in center

Sticking Garage Doors

IN THE winter, swinging garage doors often stick and freeze along their bottom edges. As a result, every bit of snow that accumulates on the driveway in front of the doors must be cleared away before the doors can be opened. You can make this less of a chore, however, by altering the construction of the doors and supplying an oak sill. Since it is generally the snow and ice on the driveway directly in front of the seam between the two doors that causes the trouble, cut the door bottoms at an angle as shown and install a triangular sill that will provide about four inches of center clearance.—J. D. G.

Oiling Cylinders

HERE is a simple device for quickly introducing any given quantity of oil into the upper cylinders of a new or reconditioned motor during the initial running-in period. It is made up from a small, mayonnaise jar, an oil can spout, and a short pick-up tube having an inside diameter of approximately one-sixteenth-inch. After drilling a hole in the oil can spout near its larger end, solder one end of the pick-up tube directly over the hole. The pick-up tube then is inserted in a hole in the screw top of the mayonnaise jar and a fillet of solder placed around it to hold it in place. The screw cap also should be provided with a small vent hole. To use the injector, fill the jar with upper cylinder oil and with the motor running at a fairly high speed, hold the jar so the oil-can spout rests in the air intake of the carbureter idling jet. By placing a finger over the large end of the spout for short intervals, you can cause the motor suction to draw the oil up through the jet into the cylinder.—R. J. W.

Tire-Chain Spreader

WITH the coming of ice and snow, owners of many of the modern cars may find that the jumbo hubs gracing the new wheels make it impossible to fit spring spreaders to their tire chains. Being large in diameter, the disk hubs interfere with the spring links of the spreaders. However, spreaders that will fit can be made from narrow bands cut from a worn-out inner tube. Five bands will be needed for each wheel. The spreaders are hooked to the side chain at equally spaced intervals by means of hooks made by opening the looped ends of cross-link fasteners taken from an old chain.—H. F.

Rubber bands cut from old inner tube serve as inexpensive tire-chain spreaders

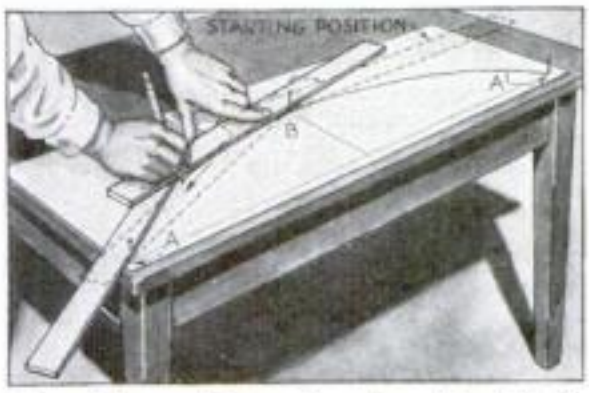
Leaking Grease Fittings

WHEN grease fittings become nicked and worn, they very often leak grease when the gun is applied. You can prevent this by placing one or two thicknesses of cheese cloth over the fitting before attaching the gun. The cloth will serve as gasket.—E. J. N.

A SIMPLE WAY TO LAY OUT LARGE ARCS

WHEN space is limited, it is difficult to lay out a large arc such as might be needed for a trellis or to form the arch for a window or door opening. This can be done, however, without finding the radius of the arc and attempting to swing in the curve from the center of the circle.

Suppose the arc is to be drawn between points *A* and A^1, which are 33 in. apart, and is to rise 5½ in. at the highest point, *B*. Place a piece of pasteboard on a plank or



Two laths are fastened as shown by dotted lines, then moved in contact with the nails

other suitable surface, and drive brads at points *A* and A^1, spacing them about ½ in. from the edge of the pasteboard. Drive another brad at point *B*. Cut a 4-ft. lath in the middle and plane one edge of both pieces. Place one piece with its planed edge against the brads at *A* and *B*. Set the other against brad *B* and let it extend out straight as shown by the dotted lines—that is, parallel with the line or chord between *A* and A^1. Where the second lath overlaps the first at point *B*, fasten them rigidly together with brads.

Place a pencil in the angle where the laths come together at *B*. Keep the laths in contact with brads *A* and *B* and slide them smoothly in the direction shown by the arrow. The pencil automatically will draw the desired arc. Repeat on the other side between brads *B* and A^1. Cut the pasteboard to this line and use it as a pattern to mark the work.—C. A. K.

BLUEPRINT GIVES PLANS FOR *BREMEN* MODEL

Model of the liner *Bremen*, 20 in. long, built by George C. Denny from our plans

FOR those readers who have built either of our two miniature ship models, the *Manhattan* and the *Indianapolis*, and wish to try something a little larger yet not much more complicated, there is no better project than the ocean liner *Bremen* shown on our special blueprint No. 158A. This will be sent to any reader for 50 cents. Please use the coupon on page 84.

The length as shown on the blueprint is 15½ in., but two scales are given at the bottom of the sheet for reducing the model to 10 in. long or increasing it to 20 in., if a smaller or a larger model is desired. The drawings were prepared by Donald W. Clark, who has specialized for years in designing small whittled models.

The *Bremen* model illustrated, which is 20 in. long, was constructed from these plans by George C. Denny, of Washington, D. C.

Graceful End Table

Beginners in woodwork will find this end table with its handy book trough is easier to build than it looks to be

Designed in American Empire Style

By Herman Hjorth

Author of *Basic Woodworking Processes* and *Principles of Woodworking*

THIS end table is quite different from the ordinary types, because it is an adaptation of the American Empire period, which reached its greatest development in the designs of Duncan Phyfe during the nineteenth century. While the structural and decorative features at first glance may seem rather difficult, it will be found on closer examination that the work is not so much a matter of skill as of time and patience.

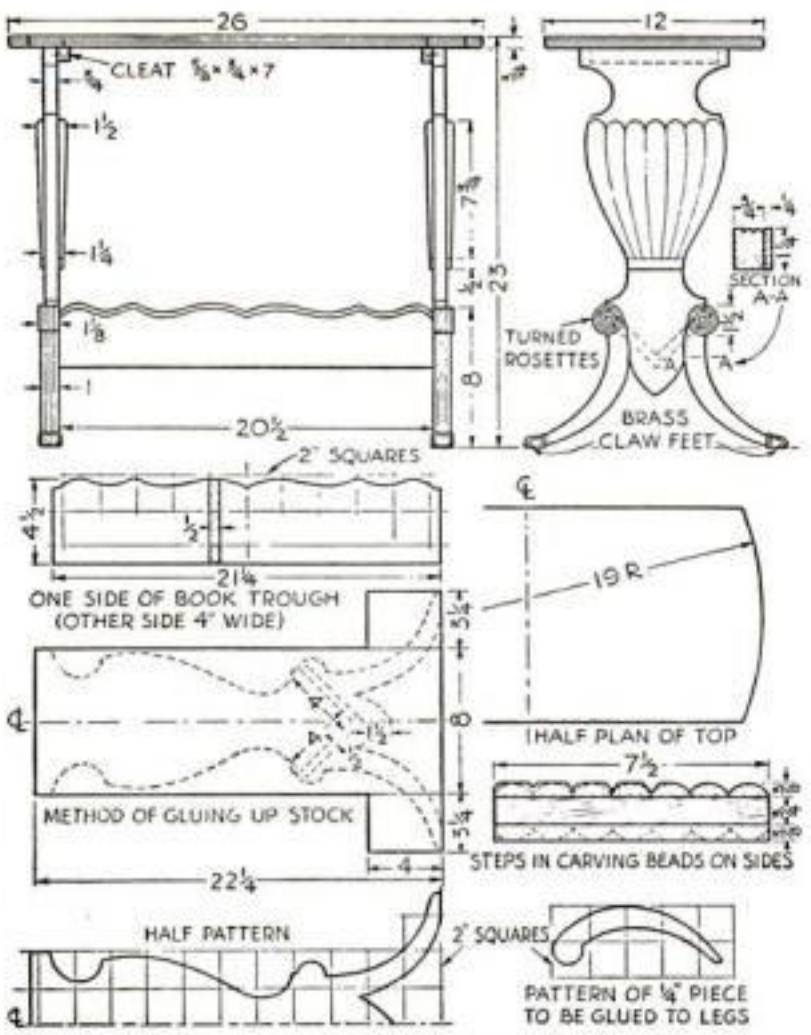
The first step in the construction is to glue up the stock for the sides. When the glue is dry, the sides are planed and smoothed on both faces. They are then nailed temporarily together and the center lines marked. The nails should, of course, be driven in the part that is to be cut away. Saw the two at the same time either on a band saw or with a hand turning saw. Next saw the four ¼-in. pieces to be glued to the outside surfaces of the legs. The grain should run lengthwise so that these pieces will strengthen the legs. Smooth the edges of the ¼-in. pieces, but do not smooth the edges of the sides until later.

The two boards forming the book trough should now be cut, shaped, and planed to dimensions. It is important that both surfaces are planed, scraped, and sanded before the joints are made. Lay out the book-trough grooves on the inside surface of both the side pieces, making their width equal to the thickness of the book-trough boards. Chisel the grooves to a depth of ⅜ in. and finish them with a router plane. Fit the book trough and the sides together, and number the boards and the corresponding grooves.

To complete the sides, four ⅜-in. boards are glued to them as shown on the drawing. These boards are then planed so that their lower ends are reduced to a thickness of ¼ in. The edges of the sides are now finished with file, scraper, and sandpaper. The beads are then laid out and carved. This can be done with a ½-in. paring chisel. First carve a small V-cut, then enlarge this and round off the sharp edges. Care must be taken always to cut in the direction of the grain. The beads are finished with scrapers and sandpaper. A strip of wood is glued across the grain of the sides at the point where the beads terminate.

The beads on the legs are made with a scratch stock. This homemade tool was described in the preceding article of this series (P.S.M., Dec. '33, p. 80). The legs may be further decorated with rosettes, either turned on the lathe or bought readymade. Brass feet are also inexpensive and add much to the appearance of the table.

The table is now ready for gluing. Use two bar clamps and two gluing blocks about ⅞ by 3 by 6 in. Clamp the table together without glue to test the fit of the various parts. Measure the distance between the sides at various points and adjust the clamps until this distance is uni-



Side and end views, a half plan of top, patterns for book trough, sides, and leg overlays, and method of gluing up stock

form at all points. Place the table on a flat surface and correct any tendency to rock by planing off the underside of the legs. When all adjustments have been made, apply glue in the grooves and on the ends of the book trough and clamp all together. Remove any surplus glue before it hardens.

The top should be made from a board that is straight and beautifully figured. It is fastened by means of cleats screwed to the sidepieces. The edge of the top may also be beaded as shown with a scratch stock.

The finish of the table will depend somewhat on the kind of wood from which it has been made. A close-grained cabinet wood is preferable. If it is to be stained, a water

List of Materials

No. of Pieces	Description	T.	W.	L.
2	Sides	¾	8	22¼
4	Sides	¾	3¼	4
4	Sides (to be beaded)	⅝	7½	7¾
4	Strips under beads	¼	½	3¼
4	Leg overlays	¼	3¼	9½
1	Book trough	½	4	21¼
1	Book trough	½	4½	21¼
1	Top	¾	12	26
2	Cleats	⅝	¾	7
4	Rosettes	⅛	1½	1½
4	Brass claw feet			
12	Screws, flathead bright 1¼-in. No. 9			

NOTE: All dimensions are in inches and are finished sizes.

stain is recommended because it is easy to apply, gives a clear color, and does not fade. Before using a water stain, the table should be washed off with clear water and allowed to dry. This treatment will raise the grain. The wood is then sanded again, and when the water stain is applied the surfaces will remain smooth.

One of the easiest and most satisfactory ways of finishing a wood surface is to apply several coats of a good grade of shellac thinned with alcohol to the consistency of water. Do not go over the surface with the brush more than once and pick up any runs immediately. Allow each coat to dry at least three hours and rub it smooth with No. 2/0 or 3/0 steel wool. The fourth coat may be rubbed down with crude oil and No. 6/0 waterproof sandpaper. Powdered pumice stone may be used in place of the sandpaper. The beads should be rubbed with crude oil and a little pumice stone applied vigorously with a brush having short, close-set bristles.

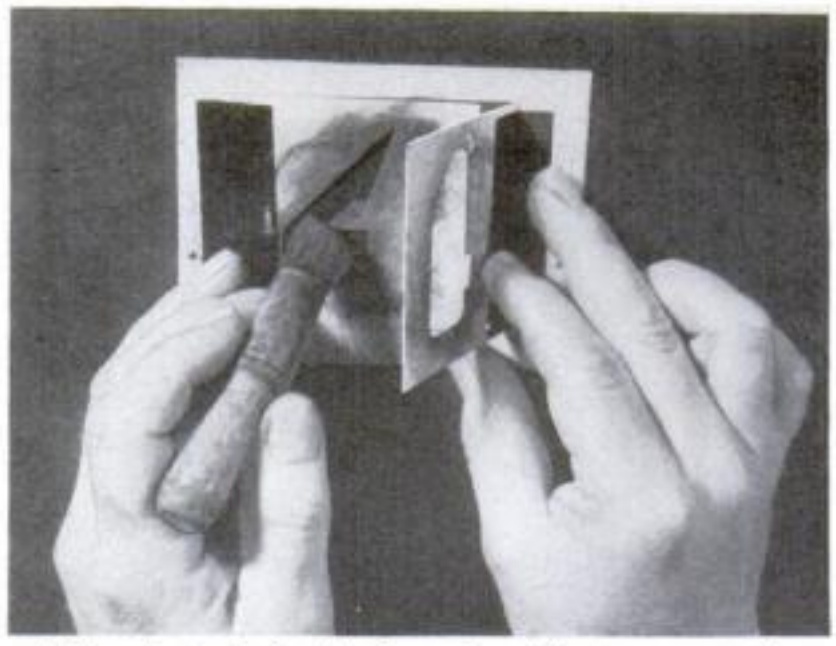
REMOVING DUST FROM INSIDE OF CAMERA

THE interior of a camera accumulates dust and fine particles of material that are likely to collect on the camera lens. This is particularly true in the case of a folding hand camera when the bellows is opened and closed frequently, thus stirring up the dust. To remove this material without a lot of bother, electrify a stick of common sealing wax by rubbing it with a piece of flannel. Insert the stick within the bellows and move it around. The foreign matter will be attracted to the stick, from which it can be easily wiped off. Repeat the operation as often as necessary.—EMIL J. NOVAK.

GAGING DEPTH OF DRILLS

THERE are many ways for gaging the depth of a drilled hole, but the little stunt I use is simplicity itself. I measure off on the drill the depth of the hole and wrap a piece of friction tape around the drill as a marker.—H. F. T.

HINGED STENCIL LEAVES NO GAPS



A hinged stencil for the figure four. First one part, then the other, is used, making a figure without unsightly "ties"

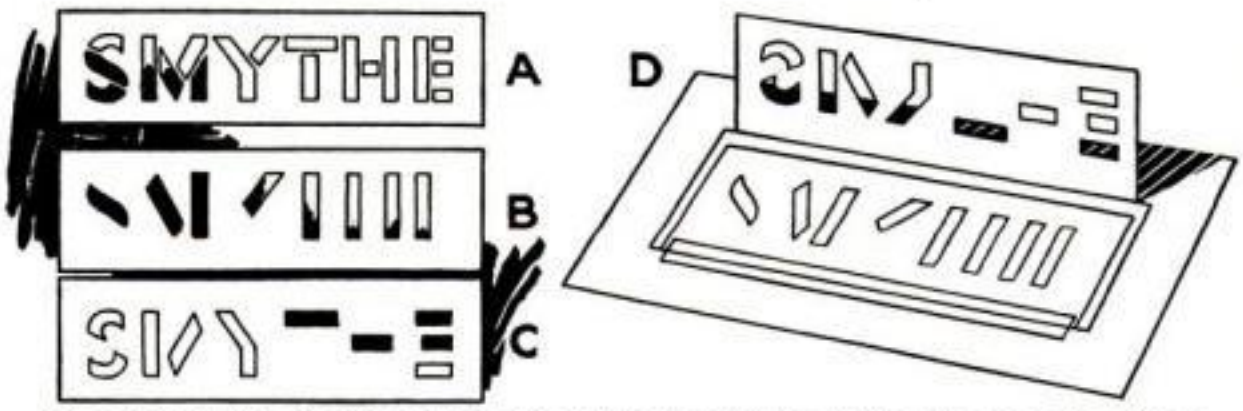
MOST craftsmen are familiar with the ordinary single stencil *(A)*, but few outside of professional ranks are acquainted with the double stencil *(B, C)*. The single stencil has "ties" or intervals between component parts of individual letters which produce a spotty appearance in the painted word or design.

The double stencil eliminates these unsightly gaps. It is made in two parts and applied in two operations. The parts are cut so that the holes forming the design overlap or supplement each other, thus eliminating the need of ties and strengthening the stencil. The double stencil's greatest drawback has been the difficulty in obtaining accurate registration of the two parts. This is usually achieved by placing the second stencil over the design painted by the first so that it appeared to be "right," or by cutting "key" slots in the second stencil to fit over designated parts of the first.

The hinged double stencil *(D)* avoids all the difficulties of obtaining accurate registration, but is practicable only with quick drying paints such as water colors, tempera, japan colors, printer's inks, and lacquers, or with more slowly drying colors when applied on highly absorbent surfaces.

The stencil frame is made either of the same material as the stencils or of a sturdier material of the same thickness. If the stencil components are of paper or fiber, the hinge may be of gummed paper or adhesive tape, which should be shellacked after application to repel moisture. If metal stencils are used, they may be fastened to a metal frame with small butt hinges soldered in place. After the first stencil section is hinged to one side of the frame, the other section is placed in register and hinged to the other side.

In operation, one section is painted in while the other remains folded back *(D)*; then fold back the section already painted and use the other section.—G.A.

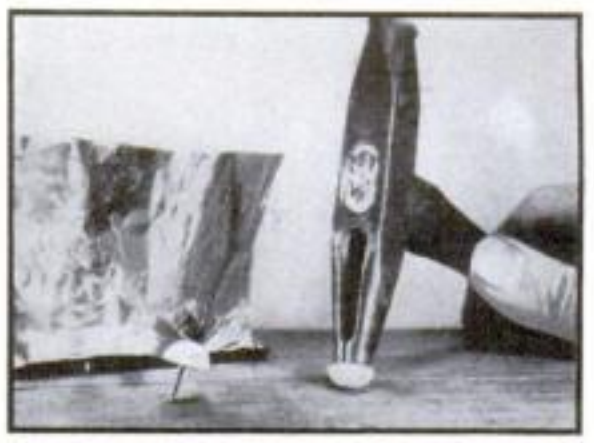


The ordinary type of single stencil with "ties" is shown at *A*; the two parts of a double stencil appear at *B* and *C*; and these are combined at *D* by hinging them to a suitable frame

TIN COVER SERVES AS TRAY FOR OIL CAN

VARIOUS holders are made to prevent a small oil can from leaving oily marks on the workbench, but one of the easiest to obtain is a smooth compression can lid, the inside of which is a bit larger than the bottom of the oil can. To prevent the can from sticking to it, use a roundheaded bolt or screw to stamp the metal down in several places close to the rim and also in the center.—F. B.

An oil can holder or tray made from a round tin cover



RUBBER TIPPED HAMMER

A SMALL size soft hammer for pounding out dents in thin copper, aluminum, or other sheet metal can easily be made by inserting a rubber-headed nail in the slotted head of a magnet hammer as illustrated. When forced into the slot, the nail will be held firmly.—R.J.M.

NEW HANDBOOKS AT BARGAIN PRICE

Think of it—only $1.00 each for these NEW cloth-bound Manuals. This low price is temporary; we may have to raise it later. Not just books of WORDS, but diagrams, drawings, directions, showing each stage of the job. Full-sized books, about 200 pages each. Sold separately—take your choice.

1 MANUAL OF SHIP MODEL MAKING How to make any model. Here are clearly diagramed the many short cuts, kinks, and time-saving methods of experts. Complete plans and specifications for a gorgeous galleon, clipper ship, etc. Almost 100 illustrations. Full cloth bound $1.00

2 THE HOME CHEMIST How to set up and operate an inexpensive home laboratory with odds and ends of material available in every home. Many thrilling, practical, useful experiments and tests, entertaining, instructive, valuable, pointing the way to research and new discoveries. Many diagrams and illustrations. Full cloth bound $1.00

3 THE INVENTOR'S MANUAL Protect your ideas. How to start, develop and complete an invention. All about patent law and Patent Office procedure in plain language for the average man. How to sell your invention. Full cloth bound $1.00

4 HOW TO BUILD CABINS, HUNTING AND FISHING LODGES, BUNGALOWS Diagrams, plans and instructions anyone can follow. Build it yourself! Now you can put up a fine cabin or small bungalow, without previous experience. How to estimate the material; cut, join, assemble and finish everything. Illustrated with plans and diagrams of most popular cabins and bungalows. Full cloth bound $1.00

5 ASTRONOMY FOR AMATEURS Easy ways to know the heavens with simple, home-made equipment, charts and guides. Opens up new worlds of wonderment—a gloriously fascinating and instructive hobby for the whole family. Many illustrations. Full cloth bound $1.00

6 WOODWORKER'S TURNING AND JOINING MANUAL The simplest, most practical ways to make end tables, chairs, benches, highboys, book-racks, cabinets, all kinds of furniture, in your spare time. A revelation of simplicity and helpfulness. Many illustrations. Full cloth bound $1.00

7 DECORATIVE METAL WORKING How to do cutting, shaping, soldering, brazing. You can easily follow these fully explained diagrams for hand-made ash trays, vases, candelabra, decorative hinges, andirons, screens, lamps and scores of other things with inexpensive, easily worked materials, requiring only simple tools. Many illustrations. Full cloth bound $1.00

8 HANDYMAN'S CEMENT WORK MANUAL How to do cement repair work, make decorative garden paths, fix sidewalks, driveways, stoops; cast cement benches, fence poles, flower boxes, feed troughs, waterproof a cellar, lay or repair foundations and other cement jobs. Numerous working diagrams. Full cloth bound $1.00

9 WONDERS THROUGH THE MICROSCOPE Turn an inexpensive microscope on hundreds of specimens within a stone's throw of your front door and you step off into a new world of wonders. Complete Manual for amateurs. How to use equipment, secure and preserve specimens, take photomicrographs, etc. Numerous Illustrations. Full cloth bound $1.00

10 500 MECHANICAL MOVEMENTS The most convenient book of the kind ever compiled. Invaluable for anyone experimenting with an invention. Easy to understand. Line drawings and plainly worded explanations make clear the principles of pulleys, gears, shafts, joints, trippers, stoppers, ratchets, grooves, hoists, gyroscopes, water wheels, pistons, pumps,—every device for transmitting motion, power, etc. 500 illustrations, full cloth bound $1.00

11 BUILD YOUR OWN BOAT Clearly explained working diagrams and plans for an outboard racer; a runabout; a sail boat; a combination motorboat-rowboat; a folding duck boat; a canvas covered kayak type canoe. Lists materials required, shows how to cut, join and finish in stage-by-stage diagrams. Many illustrations. Full cloth bound $1.00

12 BOOK OF FORMULAS For household, shop, laboratory. Formulas, recipes, methods and secret processes. Make your own beverages, glues, cements, cleaners, polishes, enamels, paints, cosmetics, dyes, inks, toothpastes, soaps, silver and nickel plate, metal alloys, photo chemicals, oils, lubricants—and scores of articles for home use or for founding your own business through making and selling. Full cloth bound $1.00

Only $1 each

TAKE YOUR CHOICE

Use Coupon Below

SEND NO MONEY!

When the books arrive pay the postman $1.00 per book plus a few cents postage. Money refunded on books returned within 5 days of receipt.

POPULAR SCIENCE MONTHLY, P.S. 1-34
381 Fourth Ave., New York, N. Y.

Send me the Handyman's Modern Manuals as indicated by the numbers checked below.

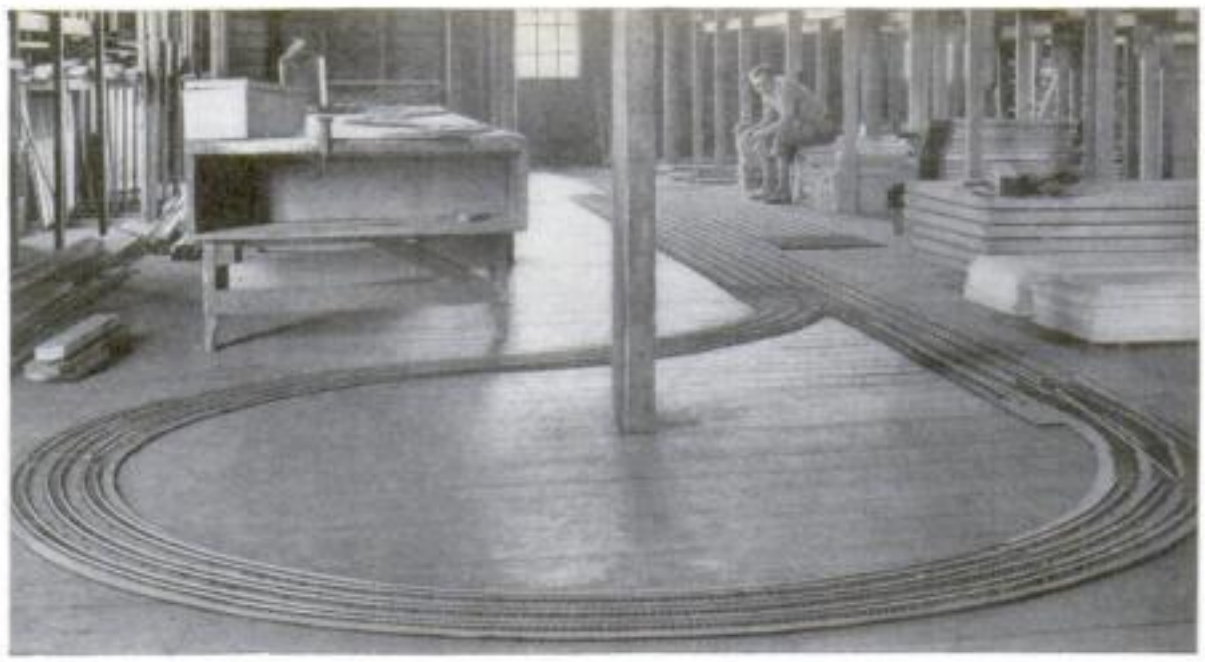
1—Ship Model	5—Astronomy	9—Microscope
2—Home Chemist	6—Woodworkers	10—Mech. Move.
3—Inventor's Manual	7—Decorative Met.	11—Boat
4—Cabins, etc.	8—Cement	12—Formulas

When the books arrive I will pay the postman $1.00 for each book delivered plus a few cents postage. You are to refund what I have paid if I return the books within five days of their receipt.

NAME .....

ADDRESS .....

CITY .....



Simple New Template Method Aids in

Laying Model Railway Track

NAPOLEON once said that an army travels on its stomach. Paraphrasing Napoleon, a model railway travels on its track, and that's only another way of saying that the success of a model railway depends largely on the perfection of its roadbed.

Of the three possible forms of track for model railroads, the simplest and most popular is the manufactured track made of tin-plated sheet steel. Any child can join standard sections of such track and get a satisfactory roadbed. Aside from the caution to handle the sections of track with care and to see that the connecting pins fit tightly, no special instructions are required. In previous issues of POPULAR SCIENCE MONTHLY there have appeared a number of ways of dealing with special problems such as the cutting of odd lengths (P. S. M., Jan. '29, p. 76, Dec. '31, p. 118, Nov. '32, p. 72, Dec. '32, p. 88).

The second possible form of model railway track is what may be termed the completely homemade type. This usually consists of steel or brass strip stock set into notches sawed into wooden crossties. Thirty years ago nearly all commercially built model railway track made in this country was of that type. It is reasonably cheap to build, but involves considerable labor in slotting the ties, a job which has to be done with great accuracy. Joints between the rails are difficult to make and clumsy in appearance. Today very little of this track is being laid because the price of steel rails formed like regular railroad rails has dropped so low that there is no longer any great saving in using ordinary strip stock.

The third form of model railway track consists in laying the formed steel or brass rails mentioned in the previous paragraph on wooden ties by means of tiny nails used in place of spikes.

At first glance this method, which so closely approximates the operations of real tracklaying, seems more difficult and tedious

Fig. 1. The laying of model railway track, whether straight or curved, can be considerably simplified by using a template that is slotted to take the ties

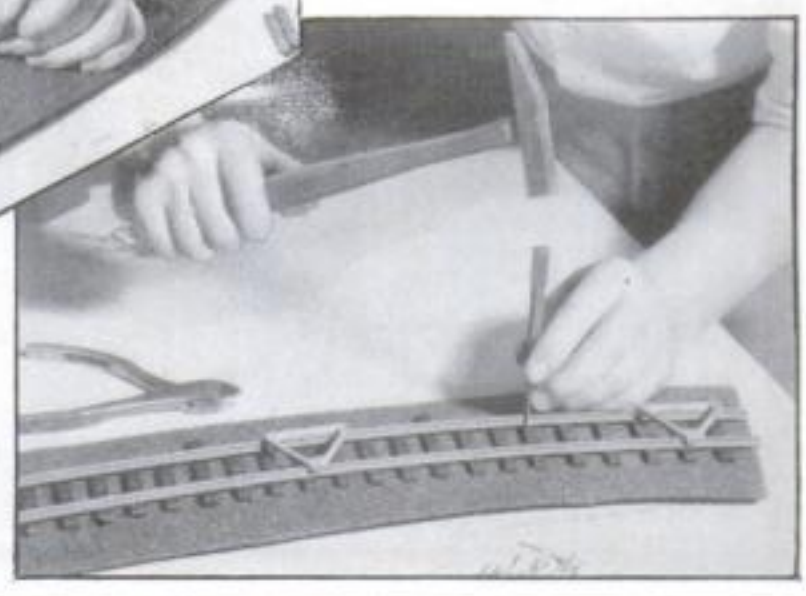


Fig. 2. When one of the rails has been nailed in place with the aid of the template, the second is spaced by means of two track gages, each with three notches

than the slotted tie system. However, certain short cuts remove most of the difficulties and make the work less tedious.

Figure 1 shows the latest way to lay track. First cut a piece of ¼-in. plywood or pressed-wood board to a straightedge, or to a curve that corresponds in radius to the inside rail if for a curved portion of track. Next cut notches into the edge of the board to correspond with the width and spacing of the ties and in depth equal to the length of tie protruding beyond the rail. It pays to take plenty of time and make these track-laying templates carefully and accurately.

The first step in laying track with this type of template is shown in Fig. 1. The base of the straight or round portion of track is first prepared from plywood covered with a strip of gravel-coated roofing paper, which is a good imitation of track ballast. Then the template is put in position, and the ties are dropped into the notches and nailed to the base with one small nail in the center of each.

The next step is to fasten the inner rail of the curve or the straight rail on the template side of the ties into place along the edge of the template with pairs of tiny nails, the heads of which hold down the edge of the track base.

The third and last step is to spike the other rail into place, using track gages to hold it at the proper spacing while the job is done, as shown in Fig. 2. Note that these track gages, which can be bought or made at home, have three notches. The single notch should always be placed over the inner rail on curves.

The method described was used in the tracklaying job illustrated at the beginning

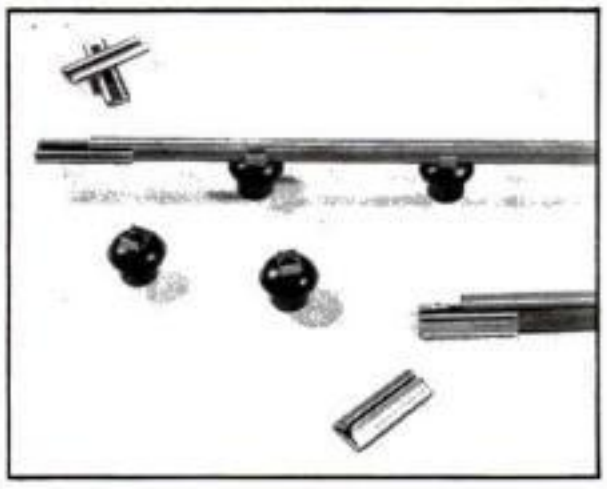


Fig. 3. Third rail mounted on bakelite insulators; connectors for third rail (shown at upper left); and steel running rail with spring brass connectors (illustrated at lower right)

of this article. The layout is part of an 85-ft. system built for exhibition purposes. It was so large that it had to be set up temporarily in a loft.

Assuming that the locomotives are electrically operated, as is the usual system for indoor railroads these days, you will need some way to get current to and from the motor in the locomotive. There are three possible methods. You can build an overhead wire system with pantagraphs on the locomotives to collect current from the wire. This method simplifies track construction but is a long-winded and delicate job if you make the overhead wire-supporting towers neat and even reasonably true to scale.

The second possibility is to insulate one wheel of each pair on every car and locomotive and then use the two running rails, which are insulated from each other by the wooden ties, for your current supply. This method was discarded by commercial manufacturers in this country many years ago.

The third method, now in almost universal use, is to install a third rail either between the running rails or at one side of them. The latter method has the advantage that it simplifies track construction and is no more work than putting the third rail in the center. Of course, side-projecting brushes from the locomotives are needed to make contact with the side third rail, but these can be made quite inconspicuous.

The cheapest way to lay a third rail, either between or outside the running rails, is to put a row of small flat-headed brass screws in the ties at regular intervals and solder a heavy brass wire or a thin, narrow strip of brass to the heads of the screws.

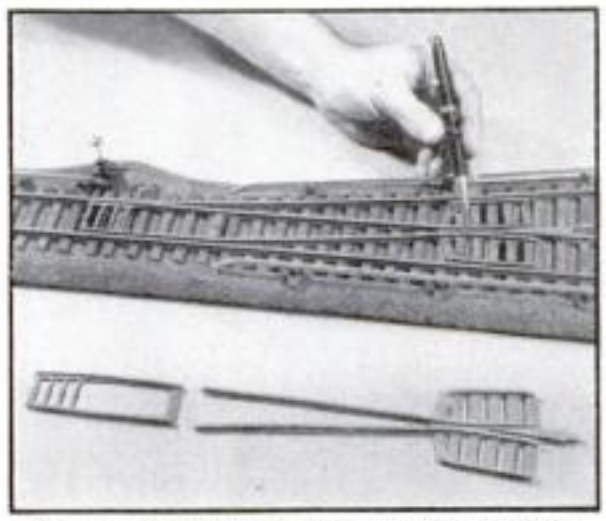


Fig. 4. An "O" gage switch assembled from stock parts, and two easily fitted castings

An easier but more costly way is to use the special third rail mounting insulators made of bakelite which are now obtainable. They appear in Fig. 3. A hole through the center takes a small nail used to hold them to the ties, and two tiny lips of brass molded in the bakelite are bent around the lower flange of the special brass third rail.

Figure 4 shows a switch fitted with outside third rail using these insulators. It also illustrates two other items that are of interest to the model tracklayer anxious to avoid some of the harder work. Below the switch you will see two castings of a new type designed to simplify making up a switch.

The question of cost naturally enters into the matter of choosing which type of model railway track you will lay on your "right of way." The regular manufactured sheet steel track costs about seventy cents a yard. The cost of homemade track put together by the slotted-tie system is difficult to estimate because so many possible sizes and kinds of material can be used. Model track of the type shown in Fig. 2, plus the third rail with all necessary fittings, including ties, will run to about a dollar a yard for "0" gage.

The "O" gage steel running rails ordinarily cost about four and one half cents a foot, so that if you have a circular saw and access to a scrap lumber pile and can therefore rip your own ties and if you will also make the third rail out of brass wire as described above, the total cost can be kept within forty cents a yard.—THOMAS W. ARNOLD.

HOW TO COPY HALF-BREADTH PLANS WITHOUT TRACING

WHEN only half of a design is given on a drawing (as is the case with ship model half-breadth plans) and it is desired to transfer the complete outline to a piece of wood, this can be done easily and accurately without tracing by using two sheets of carbon paper. Lay the back of one against the face of the other, fold the two squarely in the middle, carbon side out, and place them under the drawing. To insure that the folded edge of the carbon paper comes exactly to the center line of the design, drive two pins on that line and push the carbon paper up to the pins. After the half outline has been transferred, you will have a complete design on the back of one of the carbon papers, both sides alike, and this can be used for transferring to the work.—JAMES W. DICKENSON.

BLUEPRINTS

to aid you in your Home Workshop

TO ASSIST you in your home workshop, POPULAR SCIENCE MONTHLY offers large blueprints containing working drawings of a number of well-tested projects. The blueprints are 15 by 22 in. and are sold for 25 cents a single sheet (except in a few special cases). Order by number. The numbers are given in italic type and follow the titles. When two or more numbers follow one title, it means that there are two or more blueprints in the complete set. If the letter "R" follows a number, it indicates that the blueprint or set of blueprints is accompanied by photographically illustrated instructions which supplement the drawings. If you do not wish this supplement, omit the letter "R" from your order and deduct 25 cents from the price given. The instructions alone are sold for 25 cents each.

Flying Airplane Models

Bremen (Junkers, 3-ft.), *89-90*	$ .50
Lindbergh's Monoplane, 3-ft., *69*	.25
Nieuport XVII, 29-in., *180-181*	.50
Rise-off-Ground Tractor, 3-ft., *50*	.25
Seaplane, Tractor, 30-in., *87*	.25
Seaplane, Morris (Record 12½ min.), *102*	.25
S. E. 5a World War Plane, 30-in., *168-169*	.50
Single Stick, Tractor, 30-in., *82*	.25
Tractor (Record Flight 6,024 ft.), *104*	.25
Twin Pusher, Racing, 35-in., *86*	.25
Winnie Mae, 4-ft., *141-142-143*	.75

Boats

Canoe, Sailing Outfit, *25*	.25
Canoe, 16-ft. Canvas Covered Kayak, with Sail, etc., *192-193-194-R*	1.00
With full size patterns	2.50
Duck Boat, Folding, *170-R*	.50
With full size patterns	2.00
Outboard Racer, 11½-ft., 156 lb., *128-129-R*	.75
With full size patterns	2.25
Outboard Racer, 10 ft. 4 in., 114 lb., *211-212*	.50
With full size patterns	2.00
Sailboat-Motorboat, Combination (15 ft., cat rig), *131-132-133-R*	1.00
With full size patterns	2.50
Marconi Rig with Jib for Above, *133A*	.25
13-ft. Rowboat-Motorboat, *147-R*	.50
With full size patterns	2.00
14½-ft. Rowboat-Motorboat, *148-R*	.50
With full size patterns	2.00
16-ft. Rowboat-Motorboat, *149-R*	.50
With full size patterns	2.00
Stern Drive Installation (When used with Rowboat-Motorboat), *150*	.25
15½-ft. Runabout or "Sportboat" (outboard or inboard motor), *175-176-177-R*	1.00
With full size patterns	2.50

Furniture

Bookcase, Simple, *37*	.25
Bookshelf and Book Ends, Modernistic, *100*	.25
Bookshelves, Hanging, *77*	.25
Bookstand, Modernistic, *88*	.25
Book Trough, *68*	.25
Cedar Chest, Mahogany Trimmed, *17*	.25
Chair, Rush-Bottom, *36*	.25
Chests, Treasure, *78*	.25
Child's Costumer, *179A*	.25
Clock, Grandfather, *19*	.25
Desk, Colonial, *21*	.25
End Table, Magazine, *68*	.25
Fireside Bench, Colonial, *187A, 188A*	.50
Kitchen Table Cabinet, *27*	.25
Lamps, Modernistic, *93*	.25
Mirror, Scroll Frame, *105*	.25
Muffin Stand, Folding, *173A-174A*	.75
Pier Cabinet and Corner Shelves, *77*	.25
Radio Cabinet, Console, *70-71*	.50
Screens, Modernistic Folding, *91*	.25
Sewing Cabinets, Two, *31*	.25
Shelves and Lamp, Modernistic, *93*	.25
Smoking Cabinet, *2*	.25
Spanish Mission Armchair, *195A*	.25
Stand, Low Modernistic, *100*	.25
Table, Gate-Leg, *24*	.25
Table, Tavern, *105*	.25
Table, Tilt-Top, Oak (Top 20 by 24 in.) *140*	.25
Tea Wagon, *13*	.25

Radio Sets

Amplifier, Three-Stage, Audio-Frequency, *42*	.25
Full Electric Headphone Set, *130*	.25
One Tube (Battery Operated), *103*	.25
Screen-Grid Set, *109*	.25
Short-Wave Converter Unit, *137*	.25
Amateur Short Wave Receiver, *155*	.25
Amateur Radio Transmitter, *183-184*	.50
All-Wave Portable Receiver, Battery, *217-R*	.50

Ship and Coach Models

(Construction kits are available for some of these models. See page 72)

Bark, Scenic Half-Model (13½-in.), *108*	.25
Battleship—U. S. S. *Texas* (3 ft. Hull), *197-198-199-200*	1.00
Bottle, Clipper Ship in, *121-122*	.50
Clipper, Baltimore (8-in.), *92*	.25
Clipper Ship (20½-in. Hull), *51-52-53-R*	1.00
Clipper, Simplified (9½-in. Hull), *219*	.25
Constitution (21-in. Hull), *57-58-59-R*	1.00
Covered Wagon (23½-in.), *118-119-120-R*	1.00
Cruiser *Indianapolis* (12 in. long), *216*	.25
Destroyer—U. S. S. *Preston* (31½-in. Hull), *125-126-127-R*	1.00
Galleon *Revenge* (25-in.), *206-207-208-209*	1.00
Galleon, Spanish Treasure (24-in.), *46-47*	.50
Hartford, Farragut's Flagship (33½-in. Hull), special prints *221-222*	1.25
Mayflower (17½-in. Hull), *83-84-85-R*	1.00
Miniature Coach and Covered Wagon for Decorating Boxes, etc., *202-R*	.50
Motorboat, 29-in. Cruiser, *63-64-R*	.75
Motorboat, Working Model (20-in.), *196*	.25
Liner—*Bremen* (20 in. long), *158A*	.50
Liner—*Manhattan* (12 in. long), *204*	.25
Pirate Galley or Felucca (20-in.), *44-45-R*	.75
Roman Galley (19-in.), *138-139-R*	.75
Sails—Square and Fore-and-Aft for Whaler *Wanderer* or any Model, *185-186*	.50
Santa Maria (18-in. Hull), *74-75-76-R*	1.00
Schooner — *Bluenose* (17½-in.), *110-111-112-R*	1.00
Sedan Chair, Queen's (12-in.), *123-124*	.50
Stagecoach (20¼-in.), *115-116-117-R*	1.00
Stagecoach (Cody), with Horses (Coach Body 13 in. Long), *144-145-146-R*	1.00
Steamboat, Mississippi (19½-in.), *94-95-96-R*	1.00
Viking Ship (20½-in.), *61-62-R*	.75
Weather Vane, Ship Model (30-in.), *66*	.25
Whaler—*Wanderer* (20½-in.), *151* to *154*	1.00
Yacht, *Sea Scout*, 42-in. Racing, *106-107-R*	.75
Yacht, 20-in. Racing, *48-R*	.50

Toys

Airplane Cockpit with Controls, *114*	.25
Birds and Animals, Jig-sawed, *56*	.25
Doll's House, Colonial, *72*	.25
Drill Press, Lathe, Saw, etc., *113*	.25
Dump Truck, Fire Engine, etc., *101*	.25

Miscellaneous

Bird-House Patterns (Full Size), *P-1-2-3*	.25
Log Cabin (Three Rooms), *134-R*	.50
Microscope Kit, Portable, for Holding All Equipment, *220*	.25
Perpetual Star Chart, *214*	.25
Tool Cabinet, Bench Hook, etc., *30*	.25
Workbench, *15*	.25

Popular Science Monthly
381 Fourth Avenue, New York

Send me the blueprint, or blueprints, numbered as follows:

No..... No..... No..... No.....

No..... No..... No..... No.....

Patterns for .....

Reprints alone for .....

I am inclosing.....dollars.....cents.

Name .....

Street .....

City and State .....

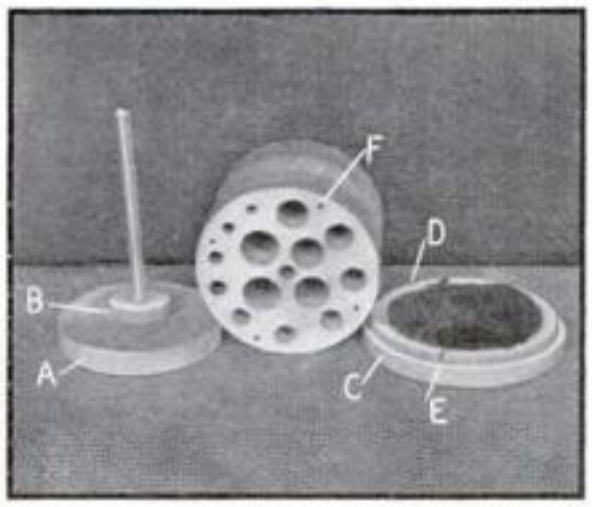
Note: Please print your name and address very clearly. If you do not wish to cut this page, order on a separate sheet.

OILED RACK PROTECTS BITS FROM RUST

AUGER bits can be kept free from rust and protected from accidental damage by making a revolving rack like the one illustrated to hold them.

Glue up a block of wood 5½ in. square and 4 in. thick, mark a 5-in. circle, and band-saw closely to the line. (If a band saw is not available, the rack may be left square and the revolving feature omitted.) Make base *A* ¾ in. thick and 4½ in. in diameter. Part *B*, which serves as a washer, is ½ in. thick and 1¾ in. in diameter. Bore a ⅜-in. hole in the center of each and fit and glue a ⅜-in. dowel 7 in. long in them, being sure the dowel stands vertically. Make a disk *C* ½ in. thick and 6 in. in diameter, and another disk *D* ¼ in. thick and 5⅜ in. in diameter. Then cut out the inside of *D*, so as to leave a ring of wood ⅝ in. wide. This can be done by entering the band saw at any point as indicated at *E*. Then glue and brad *D* to *C* as shown and bore a 7/16-in. hole in the center of *C*.

The revolving rack and an assortment of bits



The parts of the holder. The bits rest on an oiled felt disk which fits within ring *D*

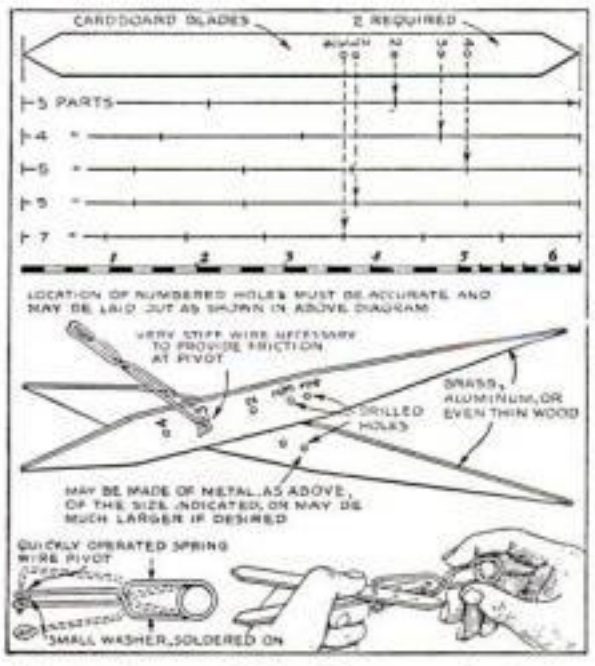
Find the center of the top and bottom of the rack, and make a pasteboard pattern to show where the hole for each bit should be bored. One accurate way to do this is to cut a disk of paper the size of each bit, place each to best advantage on the cardboard, and mark each center with a prick point. Use this to mark the center on the top and bottom of the block so that corresponding pairs will match exactly. Bore each hole 1/16 in. larger than the bit it is to hold, and also bore a 7/16-in. hole in the center. In all cases bore partly through from one side; then bore from the other until the bit clears itself in the hole first bored.

Fit a piece of felt in ring *D*, make a ½-in. hole in the center of the felt, and bore four holes through *C* and *D* and corresponding holes in the rack as at *F* so that *C* and *D* can be fastened to the rack with 1½-in. No. 10 screws. Then drop the rack over the dowel. If a drop or two of oil is put in each hole occasionally, the bits will remain bright and in good condition.—C. A. KING.

MAKING PROPORTIONAL DIVIDERS

IF ONE'S drafting kit does not include proportional dividers, an efficient substitute for this rather expensive instrument may be easily made by the method illustrated. The dividers will be found very useful for enlarging or reducing a drawing or sketch.

The blades may be made of cardboard, brass, aluminum, or even thin wood. If of cardboard, cut the two blades to the shape shown in the upper diagram; if of stronger material, taper them as suggested in the larger perspective drawing. Then mark the blades as accurately as possible for the holes. The principle of laying these out is made clear by the divisions on the five lines drawn immediately below the pattern for the cardboard blades.



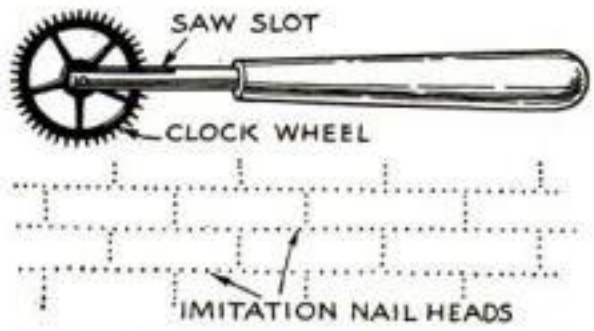
How to lay out blades for proportional dividers, and a quick acting spring wire pivot

If, for example, it is desired to enlarge a drawing to exactly twice its size, the blades should be divided lengthwise into three parts and the hole made at one of the divisions so that, when the instrument is assembled, the distance from the pivoted joint to the one end will be exactly twice the distance from the joint to the other end. Similarly, to enlarge three times, the blades must be divided into four parts and the pivot hole placed at a point one quarter the length of the blades from one end. Other divisions can be worked out in the same way. For small work, a good length to make the blades is 6⅜ in., as indicated by the inch scale placed beneath the lines upon which the divisions have been marked.

The pivot should be quickly removable for setting the blades. The wire design shown has given satisfaction and is not difficult to make.—J. D. G.

FARRAGUT'S FLAGSHIP *HARTFORD*

(Continued from page 59)



Tool made from a wheel taken from a watch for imitating nails on the copper sheathing

deck. The forecastle has to be hollow, so we make a piece as shown at *F* and cut the inside of it to the given line. The after end is the thickness of the bulwarks, and some wood should be left forward for outside shaving and gluing. This piece will be ¼ in. thick aft and 13/16 in. forward, and will have a deck 3/32 in. thick, out to its edges. This deck is not yet put in position.

From pieces of 3/16-in. hardwood, cut the stem and beak, sternpost, and keel. Glue and nail or rabbet these to the hull. Note that the keel extends to the rudder trunk. The rudder trunk is fastened to the keel with a scarfed (notched) joint and set into a hole in the counter.

The bulwarks are really of inside and outside planking fastened to the timberheads, but as none of this shows I made mine of strips of semihardwood 3/16 in. thick. The shape can be obtained by pinning a piece of cardboard outside the hull and marking the deck level. They are ⅝ in. deep from end to end. If the ports are cut out beforehand, which is really better than to cut them afterwards as I did, make the cuts from the top edge to within 3/16 in. of the bottom. Then they can be glued on the edge of the deck and nailed through the port sills. Be careful that the sides of the ports are upright when in position.

The ports in the bow are closed, so only V-cuts are necessary to indicate them. Round pieces are glued on to represent bucklers (plugs). Because of the curvature of the bow, the ports appear to slant, but in reality they are upright and the same size as the others. The stern ports were used as windows, so should be cut in about ⅛ in. and have windows set in them. The windows are pieces of clear celluloid glued on a dark blue backing, with white sashes ruled on. These details will be illustrated with additional drawings and photographs in a following installment.

The quarter galleries, containing the admiral's and captain's bathrooms, can be made of solid pieces of soft wood. Start with a piece ⅜ in. thick; cut it to the outline given at *H* on the sheer plan; then cut the inside to fit the hull. I filled in underneath with a little plastic material. Cut the vertical part to the depth of the gun port, and make a curve above to the edge of the deck and two flat planes beneath. For the moldings I used thin strips of spline (cane).

Before leaving you until next month, a word regarding the painting will be in order. If the hull up to the water line is to be sheathed in real copper, this should be done first. Shim copper about .001 in. thick is the most suitable and can be glued on. I made mine in three strips of about equal widths at the ends. Before gluing them on, I marked from the back the edges of the plates with a little wheel made as shown from a watch sprocket with the teeth filed a bit sharper. This tool gives the appearance of nail heads. The full-size plates are 14 in. by 4 ft. If copper is not used, that part of the hull should be painted copper color and some green should be added to indicate verdigris. Real verdigris can be formed on genuine copper with strong vinegar to which a pinch of salt and a little ammonia have been added. Soak a cloth in this, lay it on, and leave it overnight. When dry, brush off the superfluous green and use steel wool to polish the copper a little at the bends. I did this and then applied a coat of thin, clear lacquer to keep it in that condition.

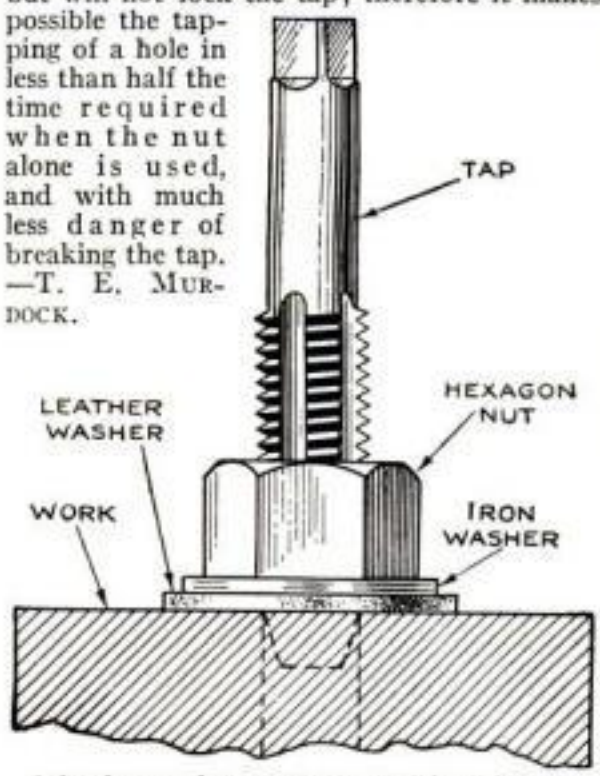
Above the copper the hull is black, except from the edge of the deck to the top of the gun ports, which is white. The *Hartford* has been painted differently at different times. She has usually been all black, but at one time was a light lead color. There is one photograph of her in 1862 with the white stripe, which is, I think, the best looking.

The decks should be scribed with fine black lines, say 1/10 in. apart, to represent the edges of the deck planks. I use a 4-H pencil for this. The decks are then given a coat of thin varnish, but this must not be shiny.

(To Be Continued)

NUTS AND WASHERS SERVE AS GUIDE FOR TAP

IT IS difficult to tap a hole by hand so that the threads will be square with the face of the work, no matter how true the hole is drilled. Some mechanics who happen to know the kink make a practice of facing the bottom of a nut and screwing it on the tap. Then they gradually turn the nut up as the tap goes down. Unfortunately, the tendency of the nut is to lock the tap so that the process is slowed down. This difficulty can be completely remedied, however, by the simple expedient of placing a flat iron washer against the bottom of the nut, after it has been screwed on the tap, and then adding a second washer of shoe leather. The latter, which comes in contact with the work, is so elastic that it keeps the tap from being locked by the nut, while the intervening iron washer prevents the nut from tearing the leather. With this assembly the nut can be screwed down tight enough to keep the tap vertical, but will not lock the tap; therefore it makes possible the tapping of a hole in less than half the time required when the nut alone is used, and with much less danger of breaking the tap. —T. E. Murdock.

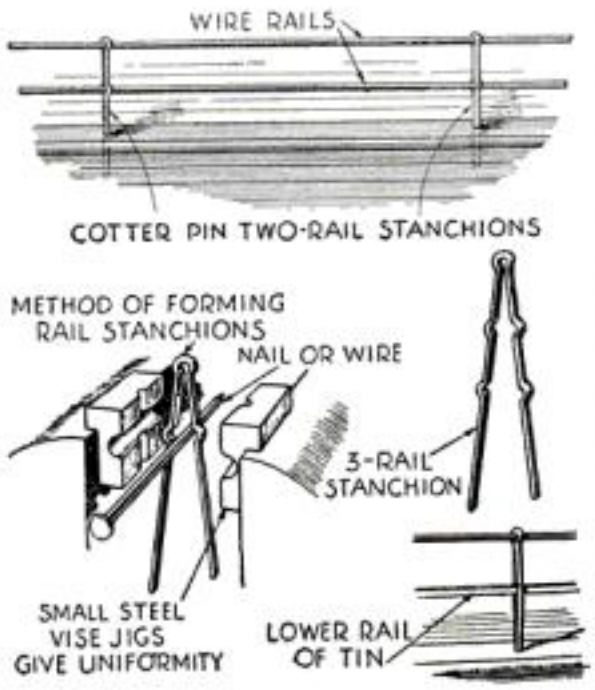


A leather washer prevents a nut from becoming locked when used as a guide for tapping

Note: *Captain McCann's series of general articles on ship model construction (P. S. M., Sept. '33, p. 60, Oct. p. 68 and Nov. p. 66) will be resumed when the new* Hartford *series is well under way.*

SHIP MODEL STANCHIONS FROM COTTER PINS

SPRING cotter pins, which can be obtained in a large variety of lengths and diameters, make excellent stanchions for model boat rails. A piece of wire of suitable gage is run through the open end of each cotter pin. If two rails are wanted, a thin strip of tin may be used to represent the lower rail; this is placed about halfway down in the split between the two legs of the cotter pins. With a little more work, a wire instead of a flat strip can be used for the second rail.—ROBERT FOLGER.



Stanchions for the rails of ship models may be made from very thin spring cotter pins

HOMEWORKSHOP GUILD

(Continued from page 65)

visited Rockford to familiarize themselves with the work of the Guild, and they have given their time generously in assisting in the preparation of the Guild's literature. The magazine has also borne the cost of preparing and mailing many thousands of letters and bulletins from its New York offices in order to spare the Guild officers as much clerical work as possible. Furthermore, the publishers are providing a free subscription for the secretary of every local club affiliated with the Guild. All this has been done without cost to the Guild.

Those who make a hobby of craftwork have heretofore struggled along very much alone. They haven't enjoyed the stimulation of meeting and working with others who have similar interests. The National Homeworkshop Guild is changing all that. It stands for a new deal. To learn more about it, just fill out the following coupon.

National Homeworkshop Guild
c/o Popular Science Monthly
381 Fourth Avenue, New York, N. Y.

I am interested in the home workshop club idea and wish to know what the National Homeworkshop Guild will do for me. Please send me this information in the large self-addressed and stamped envelope I am inclosing.

Name .....

Address .....

City..... State.....

(Please print very clearly)

AIRPLANES KEPT FLYING BY GROUND CREWS

(Continued from page 24)

the inspection just described is called a ten-hour inspection it is given the air liners after each flight. After twenty-five flying hours there is another inspection that includes all the items in the ten-hour inspection and, in addition, such operations as checking the breaker ponts in the ignition system and checking all valves and other working parts.

AT THE end of fifty flying hours there is another and even more rigid inspection, and after 100 hours of flying, the air liner receives a going over as thorough and as severe as is the annual inspection given all licensed planes by the Department of Commerce.

After 350 hours of flying service, the engines are removed from the plane and sent to the shop for a complete overhaul. New motors are installed in the ship. The old engines are taken apart, all worn parts replaced, and then reassembled. After running satisfactorily for six or eight hours on test blocks, they are replaced in a plane and given a thirty-minute test flight. If they prove satisfactory, they are put back in active service.

After 300 hours of flying service, the instrument board also is taken from the ship and a new one installed. The old board is sent to the shop for thorough testing, and for any repairs to the instruments that may be necessary.

After about 2,000 hours of flying, the air liners themselves are sent to the shop for an overhaul that is practically a rebuilding. The wings, fuselage, and tail surfaces are stripped of all covering, and the frames examined with extreme care. New parts are installed wherever they are needed. Every detail of reconstruction must be approved by an inspector. After the ship comes out of the overhaul shop, engines are installed in it, and it is flown by several test pilots. It then is turned over to the Department of Commerce for testing. If approved, it is returned to service.

The air liner of today doesn't spend nearly so much of its life in the shop as did the passenger plane a few years ago. Modern simplified plane design has made inspection, maintenance, and repair quicker and easier.

The passenger transport line operators are keenly interested in keeping their air liners flying safely and efficiently, but they aren't worrying about making them last a long time.

MORNING had come. Overnight planes from the West and the South roared down on the landing field and taxied noisily to their terminals. Passengers got out and hurried aboard the New York busses.

In the hangar the little tractor clutched the tail of one of the huge Condors and dragged it outdoors. Mechanics climbed aboard, and soon the three motors were roaring and the three propellers whirling. Then, when the engines were well warmed for their work, the tractor took charge again, and the spic and span air liner was towed to its starting place.

Mail and baggage were placed aboard. Passengers, morning papers under their arms, strolled out to the plane and entered its cabin. Pilot and co-pilot, natty in their blue uniforms and brass-bound caps, entered the control cabin. The door was closed and the porters stood clear. The engines roared. The starter dropped his flag. The Condor rolled smoothly down the runway, turned onto the field, stopped for a few moments while its engines roared even more loudly, then dashed across the field and leaped smoothly into the air.

Just another airplane taking off. But I had seen some of the planning and effort and teamwork that are necessary to keep the air liners flying, and realized for the first time that an air transport line, like a railroad, is only as good as its maintenance department.

How to Keep a Disk Harrow in Repair

By L. M. Roehl
New York State College of Agriculture

While one man holds the grinder and braces it with his knee, the other turns the disks

WHILE repairing a disk harrow, it is necessary that a gang of disks be raised free of the ground or floor so that the gang may be rotated. A pair of low sawhorses or stands suitable for this and other farm machinery repair work may be made as shown in the drawing on the following page from an 8-ft. length of "2 by 4" and a board 1 by 4 by 18 in.

If the gangs must be removed from the boxes to replace, clean, or repair the boxes, it is necessary to nail cleats to the top edges of the stands, both front and back of the shaft, to hold the gang in place while being rotated.

Usually the boxes require cleaning or replacing. If the nuts on the bolts which hold the boxes are rusted on so that they cannot be removed, they may be split with a cold chisel and then replaced with new ones. After the dirt has been completely scraped and brushed from the bearings, oil holes, and oil tubes, they may be packed in hard grease or reassembled and lubricated with oil. The top end of the oil tubes should be capped to prevent dirt from reaching the bearings.

Disks frequently become bent at the rim. They may be straightened with a sledge and hammer as shown in one of the photographs.

A gang of disks is too heavy to hold up against a grinder, so the grinder is unbolted from the bench or stand and held against the disks. If the grinder at hand is rather heavy to hold for any length of time, it can be suspended by using small pieces of rope and an old automobile tube. The latter permits the position of the machine to be regulated up or down or at any angle required by the work.

A 1 by 6 in. grinding wheel is a desirable size for the work. The grinding wheel at the other end of the grinder shaft should be removed.

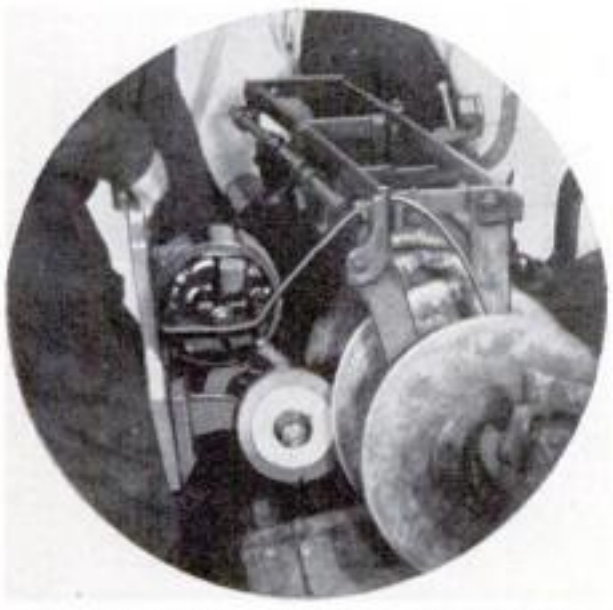
Two men are required for the work—one to hold the grinder and the other to turn the gang of disks. A pair of leather or canvas gloves will protect the hands of the one who rotates the disks.

While the disks are being turned in the opposite direction to that of the grinder, the

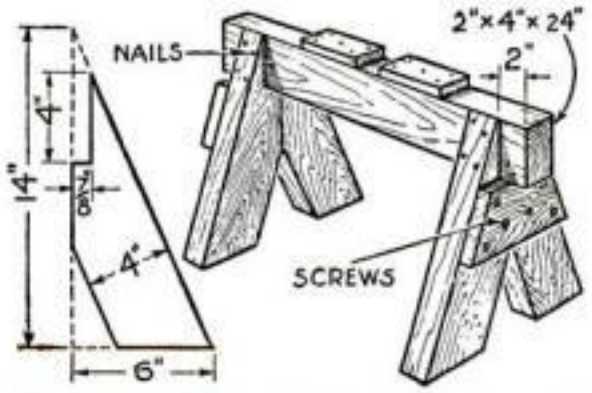
When a disk is bent at the rim, it can be straightened between a sledge and a hammer

side of the grinder wheel is held parallel to the inside edge of the disk and all irregularities ground off.

The outside edges of the disks are then ground to the desired shape and edge by holding the face of the grinder against the disks at the required angle. The workman needs to support the grinder against his knee to make the work uniform. Anyone who is not experienced at this work should be careful not to grind the edges of the disks so thin as to weaken them. Notice how the edges of new disks are ground.



All irregularities are ground off the inside edges of the disk with the side of the wheel



How to make low sawhorses or stands to aid in repairing harrows and other farm machines

WIRE RIGGING FOR MODELS

Fine copper or brass wire used for rigging airplane and ship models is usually so stiff that it is almost impossible to draw it tight without leaving some small kinks. This difficulty can be eliminated by passing a strong enough electric current through the wire to make it red hot and thus soften it; or draw it through a flame.—Jack Cunningham.

OUTPOSTS OF SCIENCE STUDY CYCLONES IN THE SUN

(Continued from page 15)

to far corners of the earth searching for cloudless skies. It has carried them across deadly deserts, through tropical jungles, among ice-covered crags. It has led them on a seemingly endless Odyssey, always seeking answers to the same two questions:

What is the rhythm of the minute changes in the heat of the sun and exactly how do these variations affect our weather?

For Dr. Abbot, the search for the answers has been a life work. Since the death of Langley, in 1906, he has been active head of the investigations. In 1911 and 1912, he went to Algeria, in northern Africa, to make observations in the clear dry air of the Sahara and compare them with records obtained at the same time on Mt. Wilson.

IN 1918, the first permanent observation post outside the United States was set up at Calana, Chile. Two years later, because of smoke from nearby copper mines, it was moved to its present site on Montezuma.

This Montezuma station is one of the strangest observatories on earth. It has no telescopes. All work is done early in the morning. At night, when other watchers of the sky are busy, the men are reading, listening to the radio or playing two-handed pinochle to while away the hours. The delicate instruments of the observatory are all underground, installed in a thirty-foot tunnel blasted from the solid rock overlooking the deadly Atacama Desert of Chile. In this cavern, the temperature changes little from day to day or from season to season.

To learn the real strength of the sun's radiation, it is necessary to measure the heat of each of the rays of color that make up a sunbeam. To do this, the Smithsonian scientists have invented the unusual instruments used in the Montezuma tunnel.

At the mouth, a device known as a coelostat reflects a steady beam of sunlight into the dark interior where it is broken up into its many rays by a spectroscope. The heat of each ray is then measured separately by a bolometer and recorded automatically on a photographic plate by a galvanometer. It takes about seven minutes to work through the solar spectrum in this manner and thus measure the sun's radiation. This is done several times each morning.

While one observer is busy inside the tunnel at this work, his mate is equally busy outside making a series of observations of the sun's altitude, the intensity of its radiation as it reaches the earth, and the heat of the rays from the sky near the sun. All of these observations must be accurately made.

The work of observing, which is typical of the other stations as well, starts about an hour after sunrise and is usually completed by ten o'clock. The result is a mass of figures that must be computed. If the fundamental, or long, method is used, there is hard ciphering until about seven o'clock in the evening. This is done once a week as a check. If the short method is employed, the computing is over by noon. As soon as the intensity of the sun's radiation, or the solar constant, for the day has been computed and checked, the results are cabled to the Smithsonian Institution.

HERE, it is compared with the data coming in from the other two permanent stations maintained by the Institution. One of these is on Table Mountain, on the edge of the Mojave Desert; the other on Gebil Zebir, the bare cone of rock that rises from the formidable Sinai Peninsula of Egypt. Few places on the surface of the globe are more remote from civilization than this mountain peak in the land of the Bedouins. Only the influence of an isolated monastery, which has been in continuous operation for fifteen centuries, makes it possible for the two Americans to carry on their work in a rough stone observatory at the top of the peak unmolested by the Bedouins.

Here, as on Mt. Montezuma and Table Mountain, the weather is an almost unbroken sequence of cloudless skies and blazing suns. The search for such clear atmosphere, vital to the tests, has carried Smithsonian men tens of thousands of miles to and fro across the surface of the earth.

In 1920, with the financial support of John A. Roebling, a station was established on Mt. Harqua Hala, a 5,500-foot peak fifteen miles from the nearest town in Arizona. In an adobe house on the crest of this isolated mountain, observers lived and worked for five years until the American station was moved to its site on Table Mountain.

IN 1925, Dr. Abbot began combing the earth for an ideal spot, the best possible site for a solar observatory. Algeria, Baluchistan, Afghanistan—strange, outlandish names on the map of the world—were the scenes of his investigations. On the borders of India, in Baluchistan, he found a peak that seemed ideal. But it had the serious drawback that a constant armed guard would have to be maintained to protect the observers from the turbulent natives of the district.

Then he tried southwest Africa. On a Hottentot reservation, sixty miles from the nearest town, he picked a site on Mt. Brukkaros. It is a 5,200-foot peak of seamed and split rock, its sides strewn with jagged fragments. Near the summit, an observatory tunnel was dug in the rock, a cottage was built for the observers, and a telephone line was run to the railroad, thirty miles away. Daily observations were started late in 1926 and continued, weather permitting, for almost five years. Because of haziness at certain seasons, Mt. Brukkaros did not prove entirely satisfactory, and in 1931, the station was dismantled and its equipment moved to Gebil Zebir, its present location.

This triangle of observatories, Table Mountain in North America, Mt. Montezuma in South America, and Gebil Zebir in Africa, now supply the data upon which weather calculations of the future may be based. Only by piling up records day after day, building a solid groundwork of statistics, can they achieve this end. So the scientists have carried on in their monotonous, dreary work far from civilization.

Their investigations have given a continuous series of solar-radiation measurements extending from 1918 to the present and a history of the association between these changes in the sun and shifts in the weather. Their work has covered the day-to-day changes in the intensity of the rays as well as the periodic fluctuations in the sun's heat due to sun spots.

These curious atomic cyclones on the face of the sun increase its activity in much the same way as poking the coals increases the activity of a fire. The result is always increased solar radiation. On the day when a new sun spot appears, the solar constant value increases. When the rotation of the sun carries the spots across its disk, the solar-constant value declines. The average of solar radiation, the researches have disclosed, is 1.940 calories per square centimeter per minute. For the period between 1912 and 1920, when there *(Continued on page 91)*

OUTPOSTS OF SCIENCE STUDY CYCLONES IN THE SUN

(Continued from page 90)

were an unusually large number of spots, the average rose to 1,946.

The surface temperature of the sun is nearly 11,000 degrees F., twice as hot as an electric arc, the hottest thing we know on earth. But for the heat supplied by this solar furnace, 93,000,000 miles away in space, our planet would be an ice-bound sphere. Although only one two-billionth of the total heat radiated by the sun reaches the earth, that heat, if it could be put to work, would develop 200,000,000,000 horsepower!

DURING one of the early experiments on Mount Wilson, Dr. Abbot did put some of it to work cooking the meals for his party. He built an ingenious solar cooker in which a cylindrical reflector of burnished aluminum caught the sun's rays and heated oil in a pipe which in turn heated an oven. Here, the camp cook boiled water, baked bread, and cooked meat without ever starting a fire. Within fifty years, Dr. Abbot believes, the problem of harnessing the power of the sun will be solved.

However, it is the relationship between the sun and changes in the weather that most arouses his interest. Already, the data that have been assembled have begun to take shape and forecasts made with them as a basis have given promising results.

The former chief forecaster of the Argentine weather service, H. H. Clayton, for example, began several years ago using the Mt. Montezuma solar-radiation figures as the basis for a weekly prediction of temperature and rainfall for the city of Buenos Aires. His forecasts were so successful that contractors and other hard-headed business men, whose affairs are affected by the weather, expressed the conviction that they had real dollars-and-cents value.

At present, Clayton is using data from Montezuma and other stations, which are telegraphed each day from Washington to his home in Massachusetts, to forecast weather conditions in the vicinity of New York City.

Dr. Abbot has found that variations of less than one half of one per cent in the waxing and waning intensity of the sun have an important bearing upon the world's weather. However, the modifying influence of mountains, oceans, winds, and vegetation play a part that must be given serious study before the new system is perfected.

BUT progress is continually being made. One recent discovery of the highest importance is that while the monthly average of the sun's radiation is apparently irregular in its variation, it really is composed of five cycles of eight, eleven, twenty-five, forty-five, and sixty-eight months each. This discovery made by Dr. Abbot marks a long step forward in forecasting the intensity of the sun's radiation at any future time.

In November, 1930, when the sun's radiation for several years had been below average, Dr. Abbot used it as a basis for predicting the average monthly radiation to the end of 1932. He stated it would be continuously above normal and that it would rise to the greatest heights observed since 1921. This forecast was remarkably close to the record of later observations. On the average, he was only three tenths of one percent from being dead right.

The accumulation of data, year after year, has been a long, slow, laborious task. But now the scientists who have devoted their time to this work feel their goal is in sight!

MICROSCOPES FIGHT POISONED FOOD

(Continued from page 13)

grim meaning to the men who unravel Uncle Sam's mysteries with microscopes. There is an illicit traffic in cigarettes which contain, not tobacco, but cannabis, the dried flowers of the East Indian hemp plant whose fibers are made into rope. The cigarettes have been found in the possession of soldiers of the regular army. Cannabis is not defined as a narcotic but its action is very much the same, and equally as deadly as many common, poisonous drugs. Indiscriminate smoking of it causes hallucinations and eventually leads to softening of the brain.

So when government inspectors or other officials come upon cigarettes that look suspicious, they send samples to Washington. Keenan or Howard, by peering at the filling material through a microscope, can tell quickly whether or not it is the brain-softening flower of the hemp plant.

The microanalyst has to be a crystal expert. Many drugs, chemicals, and even plant tissues are in the form of crystals too tiny to be seen with the unaided eye. Aspirin found in many medical preparations, has a beautiful crystalline form. So do hundreds of other compounds. The crystals are different for every substance, so that they can be used for positive identification of it.

A bottle of capsules containing a sedative comes to the laboratory. The capsules are suspected of containing a substance that is being used in violation of the food and drug law. Chemists have been unable to identify it positively, for not all materials yield to chemical analyses. Under the microscope the medicine is resolved into a mixture of drugs. One by one they are identified, and found to be permissible. There remains one. It is in the form of beautiful crystals that look like tiny jewels.

By direct observation, the microanalyst is not able to identify the substance. It looks very much like a specimen in one of the bottles of known substances on file in the cabinet of drawers at one end of the room, but he is not sure it is identical. The specimen label contains information about the refractive index—the ability to bend light rays—of the material in the bottle. So the analyst puts some of the questionable crystals on a microscope slide, adds a drop of a special oil, covers it with a thin glass slip, and places it under the microscope. The optical properties of the crystal are measured. The questionable drug matches the sample exactly, proving that it is a harmful ingredient of the medicine.

By using the optical crystallographic-immersion method, as the process just outlined is called, the microscopist can perform seeming miracles, and often can find the answer where other methods fail. He can determine whether a drug is of uniform quality or is a mixture of substances. He can ferret out adulterants or diluents.

An interesting and particularly beautiful branch of the crystallographic method is the testing for alkaloids. An alkaloid is an organic substance which has some of the properties of an alkali. Caffein, occurring in coffee, is an example. Many of the most deadly poisons are alkaloids, so their presence in foods and drugs becomes a matter of great importance.

A standard test for alkaloids consists of adding some chemical such as potassium ferricyanide or zinc chloride, and then inspecting the microscopic crystals which form. These crystals often are of great beauty, looking like fantastic snowflakes or fairy fans. One of the most carefully guarded cupboards in one of the Food and Drug Administration laboratories contains a collection of alkaloids, all *(Continued on page 93)*

MICROSCOPES FIGHT POISONED FOOD

(Continued from page 92)

deadly poisons. They are used for comparison with materials being tested, either microscopically or by determining their reactions on animal tissue.

GOVERNMENT inspectors keep constant watch over canneries to make sure that the food being prepared for market will be up to standard. In connection with this, food samples obtained at stores are analyzed. One of the common indications of insanitary conditions is the presence of one or more of the various kinds of molds. The microscope is the instrument for detecting the presence of molds, and then determining whether they are present in a quantity sufficient to make the material unfit for food.

The "what is it?" part of the mold situation is answered in short order by direct observation, because all of the microscope experts of the Food and Drug Administration learned long ago to recognize many common molds at sight, and call them by their full names. The "how much?" part of the question is answered by placing material being examined into a depression in a glass slide, and then counting the number of filaments. The shallow, circular well in the slide is of known depth and diameter, so that comparison with a standard mold count is easy. A magnification of 100 or so diameters generally is used.

Insects enter into the picture in many ways. A product containing larvae is found, for example. The larvae are identified as being from the vinegar fly. With this evidence the food experts can reconstruct the story behind the sample, and perhaps locate an insanitary condition at the source. The vinegar fly, they know, pays little attention to fruits or vegetables that are in good condition, or are only slightly overripe. It is only when decay has set in and proceeded to a point where fermentation has begun and yeast plants are present, that the fly becomes interested. The finding of the larvae of this fly in a product usually means one thing: the raw materials have not been properly handled after harvesting.

BY EXAMINING other fruits such as blackberries, raspberries, and strawberries, microscope experts can tell much about their conditions before packing. The mold-counting method is used in checking berries. Presence of mold in quantities indicates poor condition.

Fig paste comes up for examination at intervals. The microscope is turned on it mainly to determine whether insects have been involved in its preparation. Bits of wings, compound eyes, legs, and other insect parts show that something is wrong. Often the insects can be identified. It is by keeping careful watch over fig paste that Uncle Sam makes sure that you do not eat insects in your cookies.

Similar control is exercised over the quality of dried fruits, such as prunes, apricots, peaches, figs, raisins, and dried cherries. Prunes are susceptible to brown rot. Peaches and apricots may contain rotten or insect-infested material which is carried through into the finished food product. Dried cherries sometimes are infested with a mold that is difficult to discover.

And so it goes. The microanalytical laboratory at the Food and Drug Administration headquarters is never a dull place. Hardly a day goes by without a new kind of mystery to solve. And that, according to the men who are accustomed to working miracles with lenses, makes life interesting for them—and safe for you and about 110,000,000 other people.

Secrets of Success

STORIES THAT WILL HELP YOU GET AHEAD

HIS FOLDING CAMERA PAID BIG PROFITS

JOHN MILDAUER, thirty-six years of age, found himself in a very serious position when his company declared itself bankrupt about a half year ago. For several months, John went from firm to firm in a vain attempt to get work of any sort—and then, at last, he realized that if he were to support his wife and two children, it would have to be by his own ingenuity.

Luckily or wisely enough, for years John Mildauer had faithfully pursued his pet hobby, photography. For many years he had obtained tremendous enjoyment out of taking pictures with his large, postcard size folding camera. Gradually this hobby had led him into other associate fields. He had become fairly proficient in the technique of developing and printing his own films. Now that this hobby of his was to come to the rescue, he could be thankful that his preliminary training in these matters was all that it should be.

One bit of human psychology was added to his recipe, and John was ready to begin work. He realized that nothing is closer to the heart than HOME! Therefore, in a few words, John's purpose was to find a neighborhood where the people were wealthy enough to own their own homes—but not so wealthy that they had actual mansions.

After finding the neighborhood, John's business was simple enough. The homes that looked attractive and were well-kept were his "meat." Quietly, he snapped a view of each of the attractive houses—and as quietly returned home. In no case did he speak to the owner of the house. Immediately on returning home, John developed and printed the films he had exposed. He was now ready for the last stage of his job.

RETURNING to the homes of which he had taken pictures, he spoke to the owners. In each case, he had the pictures already made and ready. John found it a relatively simple matter to convince his patrons to have the picture transferred to the front of a half-dozen or dozen postcards!

The idea seemed to click 100%. Everyone seemed delighted to know that they could send out postcards which would carry views of their houses on the picture side. When John approached the local postcard company he found them equally enthusiastic. It was an unexpected source of revenue for them, and they could transfer the pictures at a very slight cost to him. *(Continued on page 95)*

Always mention POPULAR SCIENCE MONTHLY when answering advertisements in this magazine.

Secrets of Success

HIS FOLDING CAMERA PAID BIG PROFITS

(Continued from page 94)

John's business has now reached amazing proportions. He is out in the air all day—and has made between fifty and seventy-five dollars each week!

As John speaks of it, "Anyone can do it. People are always proud of their own homes—and love to show it to others. What better method than the postcard? The rates are twenty cents each for a half dozen order and fifteen cents apiece for orders of a dozen or more. The rates are fair—the profits fairer! What more can one ask?—W. H., Cleveland, Ohio.

• • •

TRAINING IS KEYNOTE OF THIS MAN'S SUCCESS

IN these days and times it is refreshing, to say the least, to find someone who is actually carrying on in the good old tried and true way of paying strict attention to business. Herbert Smith, of Hawthorne, California, is such a man. He does not talk depression, and he is always keeping an eye open to advancement in his chosen work.

"Why not?" you ask. "He has a good job and probably no worries." But that isn't the whole truth. The first path to his success was far from an easy one. One of his greatest youthful ambitions was to go to college. It seemed the *only* way to the career he so strongly desired. But the untimely death of his father put an end to those aspirations. And like many another young man he entered the world of affairs as a workman, not a college graduate.

Looking around for the kind of a job that would lead to his ultimate goal—electric engineering—he secured work in a power house at Redondo Beach, California. After three years, he began to realize how much he lacked in the way of a rounded experience. He left the job to ship on an "oiler" on a freighter plying between ports in the far East. Any man who has ever gone to sea will tell you this is work—and then some!

While thus employed, he decided that the next step in his career would come through education and not mere work. He took up a correspondence course in electrical engineering. That was back in 1922—the year which marked the outstanding milestone in his business life.

Soon after this Herbert Smith went to work for the Standard Oil Company, and before long *(Continued on page 96)*

Secrets of Success

TRAINING IS KEYNOTE OF THIS MAN'S SUCCESS

(Continued from page 95)

was promoted to fourth assistant engineer on one of the oil-boats. Then, in preparation for greater things to come, he switched his correspondence course to one in steam-electric training. Next we find him transferred from the oil-boats to the big refinery of the Standard Oil Company at El Segundo, California, where he was put in charge of the Knowles coke ovens, the position which he is now holding.

The importance of this work is best realized by one who has visited this plant. It is one of the largest refineries operated by the Standard Oil Company.

"You prepared yourself back in 1922, when America was sitting on top of the world. Isn't such preparation more necessary today than ever before?", Mr. Smith was asked. He was not long in answering. "Yes," Smith said. "The time is *really* here when training and application *alone* will count at all. Money spent in training today is a double investment for tomorrow."

That isn't theory. Herbert Smith is still preparing. "I have practically finished my Steam-Electric Course and now I'm hard at work on mechanical draftsmanship. In other words, I'm still preparing for the future."

Cash Prizes

THIS department will give $5.00 for every true success story submitted by readers of Popular Science Monthly, and which is accepted for printing in this magazine.

Manuscripts will be judged on the individual merits of the case and circumstances involved. Only stories in which the author's success, or that of some one known to the author, has been gained by some method of educational guidance, fitness for the job, or application to the work will be considered. We are not looking for the "get-rich-quick" type of story.

Manuscripts must be confined to 500 words or less. They must be true and, if accepted, authors must be prepared to give us signed statements to the effect that they are true. Manuscripts submitted and printed become the property of this magazine, and we are not responsible for the return of rejected stories unless postage is provided for this purpose. Address contributions to Success Story Department, Popular Science Monthly, 381 4th Avenue, New York City.

HOW ASTRONOMERS FIND STAR DISTANCES

(Continued from page 35)

little adhesive tape. On a clear evening shortly before full moon, select a window through which the moon can be seen an hour or two after it rises. Then stick two strips of adhesive tape horizontally upon the glass about an inch and a quarter apart.

If you have a window with old-fashioned movable slat shutters, you can close one and use the space between two adjacent slats instead of the tapes on the window pane. Finally, place a pile of several books on the corner of a movable table and you are ready for the observation.

THE idea is to look at the moon between the tapes, move backward until the moon's image just exactly fills the space between them, and then measure accurately the distance of your eye from the tapes. The corner of the top book on the pile, brought close to the eye, will help in fixing the point where the eye-ball was when the moon exactly filled the space.

When this point is ascertained, measure carefully the exact distance from the book-corner where your eye was to the tapes on the pane. Also verify painstakingly the exact width of the space between the tapes. Then you can calculate the diameter of the moon by a simple proportion in arithmetic.

The only figure you must take on trust is the moon's distance from the earth, roughly 239,000 miles. The other measurements needed you have made yourself. Here is how to figure out the moon's diameter:

(The distance of tapes from eye) is to (the distance between tapes) as 239,000 is to (the moon's diameter).

It will be well to make your observation and measurements three times, taking the average of the three distances from the tapes to the eye.

Here are the results from the experiment as I tried it. Average distance of tapes to eye, 137.5 inches. Distance between tapes, 1.25 inches.

$1.25 \times 239{,}000 = 298{,}750$

$298{,}750 \div 137.5 = 2{,}170$ miles

The moon's diameter, measured in this crude way, comes out only one two-hundredth larger than astronomers make it by the most refined methods.

While we are making measurements of the moon, it will be interesting to see how the height of its mountains were measured. I believe you will agree that the method is extremely ingenious.

AN ORANGE held in the light of a lamp will do to represent the moon in this experiment. A small wad of chewing gum will serve for a mountain.

Turn the orange toward the lamp until the light from the lamp just grazes the top of the mountain peak. When the astronomer observes this condition, he measures through his telescope the distance from the line between the moon's light and dark parts (the "terminator") to the tip of the mountain which is catching the light. This measurement is done with a telescope attachment called a micrometer.

Since the radius of the moon is known accurately and the micrometer has measured the distance from peak to terminator, the astronomer now has two sides of a right-angled triangle. The third, unknown side, is the radius of the moon, plus the height of the mountain. One of the simplest rules in geometry enables him to obtain it. He then subtracts from it the radius of the moon, and has the height of the mountain left. Heights of many of the moon's mountains have been found by this method.

NEW FEDERAL SERVICE TO END DESTRUCTION OF AMERICAN FARMS

(Continued from page 39)

slopes as steep as twenty-eight per cent. In the Piedmont country of the South, that method of cultivation will be recommended for slopes up to ten per cent. In the extensive red hill country that extends from near New York City south into Georgia, terracing will be used on slopes up to seven per cent, and strip cropping on slopes between seven and ten per cent. On slopes between ten and eighteen per cent the seeding down of the land with thick-growing grasses will be recommended, and on slopes steeper than eighteen per cent the experts will try to induce the farmers to plant trees to hold the soil in place.

MANY farmers, unfamiliar with strip cropping, are likely to object to the method because it reduces the proportion of the land planted with money crops. Soil Erosion Service experts expect to overcome their objections by showing them what strip cropping does for the farmer.

Used under right conditions of slope and soil, it stops soil washing. It also encourages the rotation of crops that keeps the land from becoming impoverished by the drain of growing the same crop year after year.

Strip cropping such as now is being used on the prosperous Easton farm, near La Crosse, Wisc., will be used to convince the doubting farmer of the value of the system. Although the average slope of the fields of this farm is twenty per cent, the corn grown in them is of excellent quality, and there is almost no loss of soil. A six-year rotation of crops is used. Planting is in strips about 100 feet wide. This year the strips, from the top to the bottom of the slopes, were alfalfa, barley, alfalfa, corn, alfalfa, and corn. Next year the top strip will be corn, the second alfalfa, and so on down to the bottom of the slope. The thick-growing, toughrooted alfalfa keeps the soil from washing during even the heaviest rains, and enriches the land for the following year's corn crop.

Ruined and abandoned farms are tragic object lessons of the evils of soil erosion. But even more serious is the damage that is being done to some of the richest crop lands in America.

There is, for example, the famous cotton-growing Black Belt of central Texas. Slopes are gentle, averaging no more than five per cent. Yet at every heavy rain, the rich black soil melts away like so much sugar. There are no unsightly gullies, no easily seen signs of the tremendous damage that is being done. For here sheet erosion, the slow but implacable variety that takes a film of soil off an entire field, is getting in its deadly work.

STRIP cropping experiments in the Black Belt have been highly successful, and it is probable that the method will be adopted generally throughout this region.

Another exceptionally rich farming region that is being damaged by erosion is the Paluse wheat belt of Washington, considered the finest wheat land in America.

In the early spring, when the snow on the crests of the hills has melted, but remains on the lower slopes, erosion can be seen at its work. You can see many tons of rich soil from the upper fields being washed over the snow on the hill sides, and so carried into the streams.

In this district the use of the Davis cultivator has been successful in controlling erosion on slopes up to twenty per cent. This machine, the invention of R. H. Davis, a soil expert of the Department of Agriculture, combines with an ordinary cultivator a set of shovels that dig *(Continued on page 99)*

NEW FEDERAL SERVICE TO END DESTRUCTION OF AMERICAN FARMS

(Continued on page 98)

10,000 shallow holes an acre. Its use gives a waffllelike appearance to the fields. Snow and rain are retained in the many shallow holes, so that the moisture sinks into the land instead of running down the slope and washing the soil away. This cultivator has been used successfully in the wheat fields of western Kansas, and now is being tested in other regions with corn and cotton crops.

Terracing is another erosion-control method that will be demonstrated and taught by Soil and Erosion Service. It is an old method, having been used in Europe and the East since long before the beginning of the Christian era. It also has been used for many centuries in the Andes Mountains of South America. It is doubtful if our farmers ever will have to go to the extremes of the Indians of Bolivia, who plaster slabs of loose shale down on a steep mountainside, and then grow their crop in the shallow troughs between the slabs.

THE cutting down of our forests and the cultivation of our land has speeded up the processes of erosion.

Before the native prairie grass was ploughed under in the Red Plains region of Kansas, Oklahoma, and Texas, the fine wheat-growing soil stayed put. But last summer, after a long drought, the loose, dry soil began blowing out of the ploughed fields of western Kansas, and continued blowing out of them for three solid months. Enough of the Red Plains was blown several hundred miles into Iowa and Nebraska to give a red tint to the native black soil of those states. The farmers of Iowa and Nebraska didn't object, for the red soil is rich stuff. But the wind erosion cost the wheat growers of the Red Plains millions of dollars in damage.

In the old days, when the farmer followed on the heels of the frontiersman, and the frontier moved ever westward, the destruction of land by soil washing or unwise farming didn't seem to matter. There always was good land farther west. But now most of our land that is suitable for cultivation is in use either for growing crops or for pasture. So we must save all the good soil we have left. That's the highly important job of the new Soil Erosion Service.

LOGS BRING FRUIT FLIES

Logs shipped into this country from the south of France are believed to have been responsible for an outbreak of the Dutch elm disease which has attacked trees in the eastern part of the United States. The affected elms are along the line of the railroads over which the logs were transported in New Jersey, New York, and Connecticut. Six hundred and three elms have been infected and the agricultural authorities are taking immediate steps to prevent the spread of the disease. Recently, when the new U. S. Navy dirigible, the Macon, flew west to its permanent hangar at Sunnyvale, Calif., from Lakehurst, N. J., two Department of Agriculture men inspected it carefully to see that it had transported no fruit flies.

GROWING BRAIN CAUSE OF MIGRAINE HEADACHE

If you wake up in the morning with a splitting headache, it may mean that your brain is growing! At least, that is one conclusion which may be drawn from a recent report made to the American Medical Association. After special research on migraine headaches, Dr. Peter Bassoe, of Chicago, has advanced the theory that such pains are due to the brain growing faster than the skull.

QUEER THINGS HAPPEN TO PEOPLE IN AUTOMOBILES

(Continued from page 37)

through the rear window of the machine, the car swerved to the curb and two men leaped from the front seat and ran. In the rear, the policeman found three other men. One was rigid in death, shot through the heart. The other two were wriggling, struggling, trying to get away, gripped in the death-locked arms of their companion.

Automobile accidents range from the absurd to the tragic, from the results of odd quirks of psychology to the products of spectacular, ungovernable twists of fate.

Traffic officers have to be prepared for the unexpected. Even so, they frequently get jolts of surprise.

FOR example, when a motorcycle cop in Springfield, N. J., overtook an automobile that was zigzagging along the road, he found the driver, his hands off the wheel, peering intently into a compass held in his lap. In Chicago, after a long chase, the police overtook a car in which it had been reported, "two men were kidnaping a girl." They found two innocent clerks transporting a department store dummy.

Sometimes the unexpected twist at the end of the chase is tragic instead of ludicrous. Thus, in Scarsdale, N. Y., when a motorcycle patrolman was overtaking a speeder he saw the machine come to a sudden stop and heard the crack of a pistol. Slumped in the seat of the car, he found a business man who, oppressed by financial worries, had been so completely depressed by the prospect of an arrest for speeding that he brought his car to a stop and committed suicide.

Tests have shown that when a front tire blows out at forty-five miles an hour, it is impossible for a driver with one hand on the wheel to keep the machine under control. A Chicagoan, taking his best girl for a drive, proved the tests were right. His car swerved, climbed the curb and knocked the front porch off a house belonging to a policeman. Then the fun began!

Three other curious reports have recently come from Chicago. Peter Pennacchia was driving along a highway when Miss Pauline Stasiak smashed into him, backed away and drove hastily off. Leaving his wrecked machine by the roadside, he returned home, got his other car from the garage and started for the scene of the accident. As he turned the corner, he was smashed into again by Miss Stasiak.

AT NOON-TIME, an Illinois shoe salesman went into a Chicago restaurant leaving his car outside. When he came out, he found a thief had carefully cut a hole in the roof of the car and stolen 350 sample shoes—all fitting the left foot.

But possibly the queerest experience of any Chicago motorist occurred when a radio performer went to a downtown station to broadcast. Arriving late, he was unable to find a parking place until he discovered a vacant lot down a side street. The deserted spot proved to be part of a junk yard and when the broadcast was over, the singer found four men taking his car apart. They thought the machine had been towed in for dismantling!

In Los Angeles, Calif., a surprise almost as big greeted a driver when he came out of a post office where he had gone to buy a stamp. His shiny new sedan looked like a plug hat upon which a fat man has sat. A big elm tree, uprooted by the wind, had fallen and landed squarely on top of his car.

It was in this same western city that what is probably the most curious plea ever entered in court was made as the result of a traffic violation. Lucio Godina, a Siamese twin, had been arrested for driving his car through a red light. When the case came up, the judge suspended sentence because the innocent Siamese twin Simplicio, who was joined to his brother, pleaded that it was unfair to fine him or send him to jail for Lucio's offense!

QUEER, out-of-the-ordinary happenings have recently taken place at railway crossings. Here one-half of one percent of the accidents and four percent of the deaths in automobiles take place.

In California, near San Jose, a limited struck the stalled car of M. T. Moran, a sixty-two-year-old stage acrobat. Just as the train hit, Moran did a backward somersault and saved his life.

On a crossing near Wahpeton, N. D., Nels Bervin was frantically trying to crank his balky car when the train crashed into it. The automobile was smashed to bits, leaving Bervin, untouched, whirling the crank in his hand.

A cautious driver in New Jersey carefully slowed down and came to a stop at the lowered gates just as a fast train rounded a curve Coming up from the rear, a speeding car, with faulty brakes, struck the back bumper of the stationary machine and pushed it through the wooden barrier onto the track in front of the express. The driver was instantly killed.

Near Gansevoort, N. Y., a driver was crossing a wooden bridge at a low rate of speed when it caved in and he was seriously hurt. But, at Missouri Valley, Ia., when two speeding motorists failed to see a "Bridge Out" sign, their car hurtled across seventy feet of water and landed them uninjured in the soft mud of the opposite bank!

THREE negro ball players in Alabama were killed when a truck upon which the team was riding backed up and they fell out into a well. In Brooklyn, N. Y., a car, running wild at high speed, crashed through a brick wall without doing more than shaking up the driver!

In California, a motorist was moving along a highway at twenty miles an hour when he was injured by a fountain pen exploding in his vest pocket after he had placed his pipe beside it. In New York City, a taxi skidded through the railing of a bridge, turned a complete somersault in the air, and landed right side up on the ground forty feet below without hurting either the driver or the passenger and without even bursting a tire!

Not long ago, (Sept. '33, p. 32) POPULAR SCIENCE MONTHLY told how laboratory tests and torture-chamber shocks are employed in rubber factories to determine the endurance of modern tires. None of the tire-wrecking apparatus of the laboratory produces punishment comparable to such a drop. Often from accidents and crashes, the automotive experts learn facts and get ideas that help them develop stronger, safer cars.

Voted the oddest accident of last year by insurance companies was a crash with a curious subsequent train of events that occurred when a Lynn, Mass., florist dozed off for a moment while driving his truck at night. The machine swerved from the street, crashed into a hydrant, which sent up a geyser of water, struck a pole carrying high-tension wires, which fell setting fire to the auto and burning the florist. An electric drawbridge, operated by current coming over the wires, was crippled and traffic was paralyzed. In addition, all street lights in the district went out. For an hour or more, the section was alive with firemen, doctors, electricians, and water department men—restoring the city to normal conditions.

(Continued on page 101)

QUEER THINGS HAPPEN TO PEOPLE IN AUTOS

(Continued from page 100)

A close second was the trail of wreckage left by a speeding taxi driver coming down the Brooklyn Bridge ramp in New York. When his brakes failed to hold, the machine bounced off a street car, mounted three curbs, sent pedestrians scurrying, dragged a street traffic cable and stanchions, crashed through a news stand, cracked a subway kiosk and stopped at the head of the subway steps within an inch of plunging down them.

ANOTHER wholesale crash resulting from faulty brakes took place, not long ago, in Englewood, N. J. A truck rounded a turn too fast and struck a line of passenger cars parked side by side. It wrecked seven machines, jamming them together like a compressed accordion.

According to statistics compiled by the accident insurance companies, one out of twenty drivers, last year, was in a motor mishap of some kind. Fortunately, many of the accidents were not serious. Not infrequently, by some curious quirk of fate, the seemingly unimportant mishap turned suddenly important and resulted in serious damage or injury.

For example, a car coming from a side street in a western city just missed crashing broadside into another machine speeding down an avenue. It struck it a glancing blow at the rear. But that blow tore loose the gasoline tank and the car went up in flames.

Sometimes, events which follow an accident are as mysterious and bewildering as the causes that produce it.

In Rochester, N. Y., an auto knocked down Jose W. Kelly, formerly Mexican Labor Attache. When he got up, he had lost his ability to speak English which he had used since a young man. He could converse in Spanish, but an injury to the cells of his brain in which the English words were stored had completely blotted out his knowledge of the language.

Similarly, as the result of an automobile accident in New York, Pauline Goodman lost her sense of taste. A jury awarded her $22,500 damages when it was proved she was a cook who depended upon her sense of taste for her livelihood.

When two cars crashed in Fort Worth, Texas, shattered glass cut the tip from the nose of one of the women passengers. After she had been rushed unconscious to the hospital, a spectator at the scene of the accident found the tip and raced with it to the operating room where a surgeon grafted it in place so that she left the hospital only slightly scarred by the accident.

FOUR o'clock in the morning, according to statistics, is the safest hour of the day for driving. The fewest accidents occur then. Yet at this very hour, one of the most curious crashes took place. In Middletown, N. Y., two cars collided head-on. One driver was catapulted through his windshield, over the hoods of both cars, through the windshield of the other machine, and into the lap of the other driver.

As a final addition to this collection of accident oddities consider the experience of a Waynesburg, Pa., motorist. On a cold morning, Thomas Parkinson, son of a Pennsylvania state senator, went to the garage to get out his father's car. While warming up the engine, he was overcome by carbon-monoxide fumes. As he fainted, his head fell forward striking the button at the center of the wheel. The continued sounding of the horn attracted the attention of neighbors and he was rushed to the hospital in time to save his life!

NEW METHODS FOR CARE OF DOGS UPSET THE OLD IDEAS

(Continued from page 33)

from a moving automobile and to growl and snap at passersby, don't be surprised if a year later some stranger complains to the police about his vicious conduct. In ninety-nine cases, bad dispositions in maturity may be charged directly to the owner.

IN MOST cases intensive training is wholly unnecessary, unless for some highly specialized work. Half an hour each day of unvaried routine and the same verbal commands and the same reward when a thing is done correctly will provide healthy, out-of-door exercise and soon make the dog into a delightful companion. Speak the commands in a crisp, cheerful voice and the dog instinctively will put that snap and willingness in his effort that gives the master pleasure.

For the average dog owner, it will be sufficient if the dog will do any reasonable thing it is told and do it instantly and instinctively. Good manners and habits are essential. The dog also should leave untouched any food lying on the ground or offered by strangers. He can be easily taught to eat only his own food, and then only on command; to stay in an indicated place and to guard objects, search for them by scent, and to walk at heel without a lead. The latter saves many heartbreaks, especially where traffic is thick.

In training a young dog to have good, cleanly habits in the house, bear in mind that he will prefer to go outside as far away from his sleeping place as possible. He naturally will seek something absorbent. If he cannot go outside, the same instinct will misguide him to a rug. At the beginning, place him in a room where there are no rugs and with a newspaper on the floor. There will be no trouble.

Certain breeds are more amenable to amateur training than others. Shepherds, usually called police dogs, are more highly strung and more temperamental and consequently more receptive than the average. When it comes to actual tricks, the terrier breeds are very responsive. The backbone of most vaudeville acts used to be the old-fashioned French poodle. Chows are more creatures of habit than any other breed, and they seldom can be fooled more than once in the same way. They remember well what they are taught, though they are slow to learn.

CHASING automobiles, a primitive hunting instinct gone wrong, is a habit that eventually ends in death. However, it can be cured in a young dog. Tie him near the road or street by a long rope. Let him run, only to be severely thrown as he comes to the end of his tether. This may bruise him, but it will stop the habit and save him worse pain. Better yet, hold the line yourself and call him back when he starts toward the retreating car. If he obeys, okey; if not, jerk the rope as he nears the end of his run. It is a bad habit, and must be stopped. Whipping does not seem to help even when applied at the moment.

In taking care of these pets, remember it is no more dangerous to bathe a puppy under six months old than to wash a baby. If it is bathed in warm water and dried quickly in the warm sun or in a warm room, and then not subjected to draft or cold for a half-hour after it appears to be dry, you can wash it every two or three days without danger.

Careless drying may produce a cold or pneumonia, but it will not cause distemper. Distemper comes from infection or contagion. Some breeds are more subject to colds than others. Wolfhound, police dog, setter, greyhound and whippet puppies require a little more consideration in washing than most others.

Dogs cannot tell us how they feel, in health or in sickness. Diagnosis is largely guesswork based on former experience. Simple remedies and simple treatment are always safest, for we can in this manner be sure we are not aggravating their trouble.

It usually is the actual nursing that cures the dog. In almost any sickness, no matter how serious, keep him in an even temperature in his home or kennel, away from chills and drafts, and give him light, easily digested food. If he realizes he is being cared for by his own people, nature usually will adjust the trouble and bring him back to good health.

A CONCRETE kennel in the lee of the house serves well for all seasons, in sickness and in health. This type of house is warm in winter and cool in summer since it does not conduct heat and cold easily. A canvas drop will stop the draft, yet permit the dog to enter and leave easily. A hole in the front near the roof permits enough ventilation. A sack covering a raised wooden floor will help provide warmth.

Inside the house, a three-sided box with a mattress filled with cedar shavings will provide comfort and shut out drafts.

Frequently a dog suffering a broken leg will become accustomed to using the other three and will develop a three-legged gait. The cure is simple. When the leg is completely healed, get a piece of light wood about *the usual thickness* of the side of a small grocery box and cut in the shape of a boomerang. Whittle it down smooth, then wrap it with adhesive tape to soften it. Take the opposite leg and bend it so the foot is about one and one-half inches from the ground and cut the wood the same angle as the bend in the leg when in that position. Whip the leg in place against the board with adhesive tape, not too tight to restrict circulation. By alternating, three days on and three days off, he soon will be using the atrophied leg normally. This is simple, painless, and effective.

Some of my friends complain that when their dogs pull against the collar they choke and gag. They fear goiters will result. No dog ever pulls hard enough against the collar to injure himself, nor have I ever known any dog to have a goiter. You can break a pup's pulling habit when lead-breaking him by pulling him up sharply a few times. Most of the trouble is caused by using harness, which, because of its comfort really teaches him to pull. In fact, few breeds look well in harness and a collar will cause no harm. Even a slip collar that tightens when the dog pulls too hard will loosen when he releases the pressure.

A dog requires little room when traveling. Smaller breeds may be transported in a light carrying case with an open screen to provide air.

IF IT becomes necessary to muzzle a dog, a simple device from a single length of four-inch surgical gauze will be less bothersome to him than leather affairs, since it cannot cause any pain. This can be made by folding the gauze in the center, tying a loop in the center, passing the free ends under the mouth, where a single loop should be tied, passing these ends back of the ears and over the neck, where a second loop should be tied. Then run one of the free ends through the loop on top of the head and make tight. The animal soon will become accustomed to this muzzle.

The spring is the best season for stripping, in order to make the dog comfortable through the heat of summer. When a rough-haired dog's coat grows old and becomes loose, no matter when the season, the dead hair gives him a little warmth. *(Continued on page 103)*

NEW METHODS FOR CARE OF DOGS

(Continued from page 102)

He has a thick undercoat below that which provides all the warmth and protection he requires.

If he has reasonably warm quarters, you may strip him even in midwinter. Hold small clumps of hair between the serrated edge of a stripping knife and your thumb—and pull sharply in the direction the hair is growing. If he were living a semi-wild life he would pull out the outer hair as he runs through brush and brambles, but those living domestically will shed considerably in the house and scratch, which is the only way he knows to rid himself of the old coat.

CLIPPING, although quicker and cheaper, should not be done, because the clippers cut the old coat instead of pulling it out by the roots. They also cut the undercoat, leaving the animal without adequate protection. When the coat grows out after clipping it, it will not grow naturally. Stripping is a natural and painless process, while clipping is not.

When grooming, remember that rough-haired dogs require slightly different treatment from smooth-haired dogs. At any pet shop, you can purchase a fiber hound glove, one side of which is set with fairly soft bristles, the other with slanting wire bristles. The latter, with the aid of a comb, will smooth a coat of roughest hair. Nails should not be permitted to grow long, or you will pay the penalty in torn rugs, curtains, and silk stockings.

In their old age, dogs suffer misery with their teeth, especially those that continually chase stones and sticks. When one reaches the ripe old age of nine or ten, his teeth are likely to be worn to the gums. Very few people ever think of having those old stumps extracted, yet to do so is not only kind and humane, but also will add several years to his life. At the same time, give him food that is neither hot nor cold. Pomeranians especially suffer from their teeth. Even with this handicap, they live longer than any breed I know, and their life span could be easily doubled by proper dental care.

CLOUDS OVER EUROPE STUDIED ON ONE DAY

AN INTERNATIONAL Cloud Day was recently observed in Europe. Scientists in the various countries took pictures of the clouds at three specified times during the day, and attached to them the weather conditions at the time. This composite record of the cloud and weather over Europe is now being studied in an effort to learn more about forecasting through the observation of clouds and upper air currents. It is the first effort made to obtain a widespread pictoral record of cloud conditions at a given time.

AMERICAN WOMEN'S FEET ARE GROWING LARGER

THE feet of American women are larger today than they were ten years ago. That is the conclusion of the National Shoe Retailers' Association. The records of this organization show that in the majority of cases the selection made by American women today is size five. Ten years ago, it was size four. Earlier, it was size three. A better understanding of the nervous strain that results from wearing shoes that are too tight, as well as an actual increase in the size of feminine feet in the United States, is given as the reason for the present popularity of larger sizes.

"How Do I Know It's Christmas?"

(By A Man Who's Been Through It Many Times)

"EVEN without holly and tinsel, trees and ornaments, I'd know it. One day—every year without fail—I walk into a room where there are a lot of packages marked for me. After they are opened, I find myself richer to the tune of one dozen neckties and two dozen pairs of socks. 'This must be Christmas', I say—and so it is.

"Now, I know that every Christmas present comes from the heart, but I'm practical and I wish they'd put a little more 'head' in with the heart. Neckties come in such astounding colors that I'd rather pick my own. And you can't do much with Christmas socks that are a size too large or a bit too small.

"Just let me put in a word for myself—and for a couple of million other men like me. We like Christmas presents, and we like to give them. But when we're on the receiving end of the exchange, it does our hearts good to get a really sensible gift—of practical and permanent value. Something that gives us enjoyment, something that reminds us of the giver—makes us think of him gratefully—six months—twelve months after Christmas has come and gone."

• • •

That's a frank, man's point of view. Isn't it yours? Aren't there men you know who you're dead certain feel that way? Wouldn't such a man say you used both *heart* and *head* when you sent him Popular Science Monthly for a year, as a Christmas Gift?

You know—without our telling you—what a delight Popular Science Monthly, with its fascinating news and amazing photographs of scientific progress all over the world—can be to the man who wants and values a practical gift. When you make this gift—be he father, son, brother or friend—a year's subscription to this graphic magazine, every new issue brings him another reminder of Christmas—and another grateful thought for the friend who made so wise a selection.

While we're on the subject of gifts, we'd like to give a little Christmas present ourselves. The regular subscription price of Popular Science Monthly is $1.50 a year—but, to every reader who wishes to send the magazine as a gift, we'll give our own Christmas present of twenty-five cents, so that, for each friend to whom you send Popular Science Monthly on this special occasion, you need send only $1.25 instead of $1.50. Here, however, is a gift you cannot measure by cost, because it is so very inexpensive—and yet its worth in terms of interest and genuine pleasure for the gift receiver is invaluable. And, to carry out the spirit of the season still further, we shall mail to every friend to whom you send Popular Science Monthly as a Christmas Gift, an appropriate Christmas Card, bearing your own name and your good wishes, and telling him Popular Science is coming as your gift.

If you want to send a gift that means something—and, if you want to avoid the discomforts of last-minute shopping in crowded stores—Popular Science Monthly is certainly the solution to this year's gift problems—for every man on your Christmas list. Use the convenient order blank, sending your remittance now or indicating below that you wish to be billed for the amount after the Christmas Holidays—and mail it back to us today.

POPULAR SCIENCE MONTHLY

381 Fourth Avenue New York, N. Y.

Send Popular Science Monthly for one year on your special Christmas offer of $1.25 for a year's subscription to the names written below—and also send a Christmas Card bearing my name and greetings for each separate gift subscription.

I am enclosing $.....to cover these subscriptions.

Bill me $.....after the Christmas Holidays.
(If you wish to pay later, indicate it above)

Put Your Own Name and Address Here
(We may need it for correspondence, billing, etc.)

Name.....

Address.....

City.....

Write below the names and addresses to which you wish to send the Magazine

Name.....	Name.....	Name.....
Address.....	Address.....	Address.....
City.....	City.....	City.....

I saved ½ by buying direct from the Midwest Laboratories

Yes, and it gives you WORLD-WIDE Reception!

Amazing New SUPER Deluxe 16-TUBE ALL-WAVE Radio

9 TO 2,000 METERS

30 DAYS FREE TRIAL

BEFORE you buy any radio, write for this big new FREE Midwest catalog... printed in four colors. It has helped thousands of satisfied customers save from ⅓ to ½ on their radios... by buying *direct* from the Midwest Laboratories. You, too, can make a positive saving of 30% to 50% by buying a Midwest 16-tube de luxe ALL-WAVE radio at sensationally low direct-from-laboratory prices. You'll be amazed and delighted with its super performance! Broadcasts from stations 10,000 miles and more away are brought in... "clear as locals". You get complete wave length coverage of 9 to 2,000 meters (33 megocycles to 150 KC). Now, you can enjoy the new DX-ing hobby... and secure verifications from world's most distant stations. These bigger, better, more powerful, clearer-toned, super-selective radios have FIVE distinct wave bands: ultra-short, short, medium, broadcast and long... putting the whole world of radio at your finger tips. Now listen in on all U. S. programs... Canadian, police, amateur, commercial, airplane and ship broadcasts... and programs from the four corners of the earth. Thrill to the chimes of Big Ben from GSB, at Daventry, England—tune in on the "Marseillaise" from FYA, Pointoise, France—hear sparkling music from EAQ, Madrid, Spain—listen to the call of the Kookaburra bird from VK2ME, Sydney, Australia—etc. Never before so much radio for so little money! Write for FREE catalog.

WORLD'S GREATEST RADIO VALUE

$49.50 with New Deluxe Auditorium Type SPEAKER

• • • 40 NEW 1934 FEATURES • • •

Try this Midwest radio...in your own home...for thirty days before you decide. See for yourself the 40 new 1934 features that insure amazing performance. Other features include: Automatic Select-O-Band, Amplified Automatic Volume Control, 16 New Type Tubes, Balanced Unit Superheterodyne Circuit, Velvety Action Tuning, Super-Power Class "A" Amplifier, 29 Tuned Circuits, New Duplex-Diode-High Mu Pentode Tubes, No-Image Heterodynes, Full Rubber Floated Chassis, Variable Tone Blender, Centralized Tuning, 7 KC Selectivity, New Thermionic Rectifier, Automatic Tone Compensation, Auditorium Type Speaker, etc. These features are usually found only in sets selling from $100 to $150.

AMAZING FOREIGN RECEPTION

AKRON, OHIO—My Midwest-16 is a real go-getter for distance. Received 205 stations on regular wave band... including U. S., Canadian, Mexican, Cuban and Hawaiian stations. Also many police, airport and "ham" stations from all over the country. Have logged England, France, Germany, Madrid, Rome, on 15-30 meter band. South American stations include Venezuela, Colombia, Brazil, Yucatan.—L. H. MOELLER, 793 N. South St.

TERMS AS LOW AS $5.00 DOWN

NEW STYLE CONSOLES

Write quickly for your FREE copy of the new Midwest catalog. It pictures a complete line of beautiful, artistic de luxe consoles and chassis... in four colors! Sensational low prices save you 30% to 50%. Also shows performance curves that prove Midwest radios out-perform most of the $150 sets. You can order your Midwest radio from this catalog with as much certainty of satisfaction as if you were to select it personally at our great radio laboratories. Write TODAY!

DEAL DIRECT WITH LABORATORIES

Increasing costs are sure to result in higher radio prices soon. Buy before the big advance...NOW, while you can take advantage of Midwest's amazingly low prices. No middlemen's profits to pay! You save from 30% to 50% when you buy direct from Midwest Laboratories... you get 30 days FREE trial—as little as $5.00 down puts a Midwest radio in your home. Satisfaction guaranteed or your money back! FREE catalog shows sensational radio values. Write TODAY!

SAVE UP TO 50%

MAIL COUPON TODAY! FOR AMAZING 30-DAY FREE TRIAL OFFER AND NEW 1934 CATALOG

MIDWEST RADIO CORP.,
Dept. 390
Cincinnati, Ohio.

Without obligation on my part send me your new FREE 1934 catalog, and complete details of your liberal 30-day FREE trial offer. This is NOT an order.

AGENTS! Make Easy Extra Money

Check Here for Details ☐

Name_____

Address_____

City_____ State_____

MIDWEST RADIO CORP.

DEPT. 390 — CINCINNATI, OHIO, U. S. A.

Established 1920 Cable Address Mirace ABC 5th Edition